ADAPTATION FUND

REGIONAL PROJECT/PROGRAMME PROPOSAL

PART I: PROJECT INFORMATION

Title of Project/Programme:	Enhancing Adaptive Capacity of Andean Communities through Climate Services (ENANDES)
Countries:	Chile, Colombia and Peru
Thematic Focal Area:	Disaster risk reduction and early warning systems
Type of Implementing Entity:	MIE
Implementing Entity:	World Meteorological Organization - WMO
Executing Entities:	Chile: Dirección de Meteorología de Chile - DMC Colombia: Instituto de Hidrología, Meteorología y Estudios Ambientales - IDEAM Peru: Servicio Nacional de Meteorología e Hidrología - SENAMHI Centro Internacional para el Estudio del Fenómeno El Niño – CIIFEN / Regional Climate Center for western South America – RCC-WSA
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Table of Contents

Executive Summary

In the next decades, food production, water provision, and energy generation will take place in a context of exacerbated climate variability and change. Urbanization, economic growth, migration, and evolving social preferences and values will create additional stresses on society. Complex interactions among all these factors will pose unprecedented systemic risks to humans, ecosystems and infrastructure, calling for innovation to help ensure resource security, maintain ecosystem services, enhance livelihoods and reduce poverty.

Decision makers at many levels – households, communities, regions and countries – increasingly will need actionable scientific evidence and information to enhance their capacity to respond and adapt to the challenges and opportunities posed by climate variability and change. Despite considerable advances in climate science, potentially useful climate information often goes unused and thus stakeholders are not fully benefiting from effective climate information and services in support of decision-making, risk management and adaptation. To improve this situation, there is growing interest in enhancing the operational provision and uptake of climate services – defined as the timely provision of climate-related knowledge and information to support decisions in climate-sensitive sectors.

The proposed project *"Enhancing Adaptive Capacity of Andean Communities through Climate Services"* – hereafter "ENANDES" – seeks to enhance the capacity of society and communities to adapt to a varying and changing climate by producing, communicating and assessing the use of credible, authoritative, and useful information as the scientific evidence for decision- and policy-making on preparedness for, and reduction of damages from climatic hazards in Chile, Colombia and Peru. Because *increasing societal resilience to climate is not just about enhancing information, ENANDES* will help build human and infrastructure capacity, and will seek to overcome institutional, technological and cultural barriers through increased coordination among climate and non-climate actors of society.

ENANDES is organized around four major outcomes to promote adaptation to climate variability and change. *The first outcome* will produce a major leap in the capacities of National Meteorological and Hydrological Services (NMHSs) in the ENANDES countries to produce and communicate timely, relevant and sector-tailored climate and water information and knowledge. *The second outcome of ENANDES* will develop partnerships and strengthen linkages with several national and local institutions – governmental or from civil society – from climate-sensitive sectors (agriculture, water, energy) to ensure the communication and use of the sector-tailored information and tools to be provided by NMHSs in support of adaptation. *The third outcome* will focus on the use of climate services to inform local adaptation. This approach will implement and assess demonstration adaptation activities in various sites throughout the three countries where climate-sensitive activities (agriculture, hydropower generation, water supply) and vulnerable communities and groups (peasants, indigenous population, women and elderly people) are located. *The fourth outcome* will focus on the regional dimension of the project; this outcome will synthesize insights, good practices, and lessons learned, build human capacities, strengthen coordination and liaison with regional and global organizations, and communicate ENANDES findings so that lessons learned on climate service production and adaptation can subsequently be transferred for replication or scale-up to other contexts in western South America and elsewhere.

Ultimately, ENANDES aims to increase substantively the capacity of governments and communities in the target countries to act on climate and water information and services. The project seeks to produce useful insights, guiding principles, and "best practices" to guide adaptation to extreme weather, climate variability and change, and mitigation of their impacts on natural-human systems. The project will yield tangible experience that will facilitate operational implementation of national climate services in the three countries. Moreover, real-world lessons from ENANDES will guide the implementation of National Frameworks for Climate Services – the next step in the evolution of the Global Framework for Climate Services (GFCS), an international initiative led by the World Meteorological Organization (WMO) – which the three countries are committed to developing.

1 Project Background and Context

1.1 Foreword

Feeding, sheltering, and improving the well-being of a growing population in environmentally, economically and socially sustainable and equitable ways constitutes a major global challenge of the 21st century. Urbanization, economic growth – albeit with inequality [1] –, migration, and evolving social preferences and values will place significant stresses on food, water and energy security [2-9]. Moreover, food production, water provision, and energy generation will take place in a context of exacerbated climate variability and change. Complex interactions among all these factors will pose unprecedented systemic risks to humans, ecosystems and infrastructure, calling for innovation to help ensure resource security, maintain ecosystem services, enhance livelihoods and reduce poverty.

The impacts of climate variability and change are not only being felt now, but will very likely evolve in scope and character, for instance, as increased frequency and intensity of extreme weather events – droughts, floods or heat waves – in the next few decades [10-16]. An intensification of extremes is already emerging in the observed climate record across many parts of the world [17-19]. Such events are expected to have greater ecological and socio-economic impacts than a gradual change in temperature or precipitation averages [20-22]. Not surprisingly, extreme weather has consistently ranked 1 in likelihood and 2-3 in impact in the most recent (2014-2019) World Economic Forum's surveys of global risks [23].

Decision makers at many levels – households, communities, regions and countries – increasingly will need actionable scientific evidence and information to enhance their capacity to respond to the challenges and opportunities posed by climate variability and change [24]. Climate information and knowledge must support adaptation and impact mitigation decisions, provide straightforward estimates of uncertainty, and meet the needs of climate-sensitive sectors [25, 26]. The past 2-3 decades have witnessed considerable progress in climate science. Our ability to monitor and predict variations in climate has improved substantially: a number of groups routinely forecast climate a few seasons ahead, and these forecasts are beginning to benefit sectoral decision-making [27-35]. Active research is seeking to bridge the weather and seasonal variability scales through sub-seasonal prediction [36], and emerging developments may soon enable skillful predictions of climate conditions a few years ahead [37-40].

Despite advances in climate science, there is a general concern that potentially useful climate information often goes unused and thus stakeholders are not fully benefiting from effective climate information and services in support of decision-making, risk management and adaptation – particularly in developing countries [24, 41-46]. There is a need to "go the last mile" between users and providers; understanding why information is generally not used and embraced by decision makers is recognized as a key priority for climate services [47-49]. On one hand, there have been several studies exploring the attributes or characteristics that usable and useful climate information must have [48, 50-54]. On the other hand, research has identified theoretical and practical impediments to the use of climate information [55-62]: obstacles range from limitations inherent to the climate system to procedural, institutional, and cognitive difficulties in understanding information, or in the financial or cultural ability/willingness of decision-makers to modify their actions.

Limited uptake of climate information may be tied in part to limitations in institutional design and functions. Current institutional arrangements seem insufficient to provide the information needed for management of, adaptation to, and mitigation of climate variability and change and its impacts on natural systems and human communities. These limitations motivate the current interest on the provision of "climate services" at international, regional and national levels [42, 63-68]. *What is a climate service?* The aim of climate services is to provide people and organizations with timely, tailored climate-related knowledge and information that they can use to reduce climate-related losses and enhance benefits, including the protection of lives,

livelihoods, and property [68, 69]. This is why the Global Framework for Climate Services, an international initiative led by the World Meteorological Organization (WMO), was established in 2009 to guide the development and application of science-based climate information and services in support of decision-making in climate sensitive sectors [42, 70].

Increasing societal resilience to climate, nevertheless, is not just about enhancing information. While climate information and knowledge clearly play an important role, technical information by itself is necessary but not sufficient to enable adaptation of countries, sectors and communities to climate variability and change. Adaptation also requires building capacity, overcoming institutional, technological and cultural barriers, and stimulating social learning at the level of managerial and operating agencies and other actors (communities, firms, individuals) [71].

In short, enhancing the resilience of communities, sectors and countries to climate variability and change requires not only (i) understanding climate trends and variations on multiple temporal scales, but also (ii) understanding the likely impacts of those variations on human and natural systems and how to manage their risks and opportunities, (iii) providing decision-relevant tools and knowledge for planning and preparation, and (iv) increasing society's, communities' and individuals' capacity to act on climate information on local, national, and global scales [71]. *These needs motivate this project, which focuses on the production, communication and use of weather and climate information to support adaptation and preparedness to reduce impacts from climatic hazards in three countries of western South America: Chile, Colombia and Peru.*

1.2 Project Overview

The goal of project *"Enhancing Adaptive Capacity of Andean Communities through Climate Services"* – hereafter referred to as "ENANDES" – is to enhance the capacity of society and communities to adapt to a varying and changing climate by producing, communicating and assessing the use of credible, authoritative, and usable information as the scientific evidence for decision- and policy-making on preparedness for, and reduction of damages from climatic hazards in Chile, Colombia and Peru. ENANDES will produce useful insights, guiding principles, and "best practices" that will have an important impact by guiding adaptation to extreme weather, climate variability and change, and mitigation of their impacts on natural-human systems.

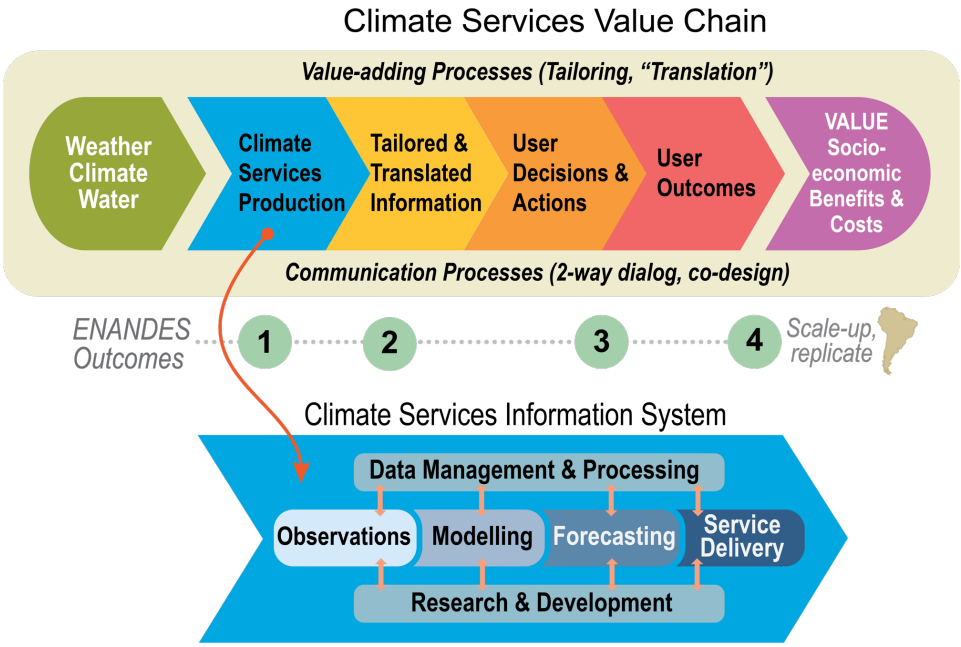
The ENANDES countries share distinctive climatic, environmental and cultural characteristics that have led the United Nations Framework Convention on Climate Change (UNFCCC) to recognize these countries as particularly vulnerable to climate change. ENANDES countries share the influence on their climate of the Andes, the most important mountain range in the Southern Hemisphere. The impressive length, continuity and height of the Andes create a wide variety of environmental conditions, including fragile mountainous ecosystems, arid, semi-arid and forested areas. All three countries have long, low-lying coasts with important fishery resources. Moreover, the El Niño-Southern Oscillation phenomenon (ENSO), the major single source of interannual climate fluctuations in many parts of the world [72], strongly affects ENANDES countries.

Ultimately, ENANDES aims to increase substantively the capacity of governments and communities in the target countries to promote adaptation to climate variability and change. To achieve this goal, the Project is organized around four major outcomes. These outcomes – and their associated outputs and activities – are discussed in detail in Section 5.2. Nevertheless, a brief summary here is meant as a "roadmap" to the proposal. The summary of ENANDES outcomes is based on a schematic depiction of the value chain for climate services (Figure 1), i.e., the suite of tools, processes and functions needed to add value to weather, climate and water observations and data (leftmost component of Figure 1, top) to produce actionable information and knowledge that informs adaptation decisions, in turn improving decision outcomes and yielding value to individuals, communities and society (rightmost component of Figure 1, top).

ENANDES Outcome 1 will introduce innovation and investment in capacity that will produce a major leap in the capacities of National Meteorological and Hydrological Services (NMHSs) to produce and communicate

timely, and relevant and sector-tailored climate and water information and knowledge (Figure 1, top). Climate information (historical, monitored, predicted) and early warning systems will enable decision makers to better anticipate and manage adverse climatic conditions, take advantage of favorable conditions, and actively adapt to change [73]. ENANDES will emphasize the coordination and interaction among the three participating NMHSs – allocating funds for visits, workshops, internships and frequent exchanges – so NMHSs can collaboratively develop necessary tools and processes, draw on their respective strengths and help one another to address capacity limitations.

Figure 1. Schematic description of the climate service delivery value chain (top) needed to turn raw observations and data (left) into actionable information that informs decisions, leading to better outcomes and yielding value to society (right). The numbers below the value chain denote the ENANDES Outcomes associated with each link. The bottom figure provides a detailed view of the Climate Services Information System. i.e., the tools and processes involved in the production of climate services. Adapted from WMO.



Outcome 2 recognizes the need for collaboration and coordination with a broad spectrum of non-hydrometeorological stakeholders in order to complete the operational delivery of climate services. Accordingly, the project will develop partnerships and strengthen linkages with several national and local institutions – governmental or from civil society – from climate-sensitive sectors (agriculture, water, energy) to ensure the communication and use of the information and tools to be provided by NMHSs. These strategic partnerships will be crucial to (i) achieve the "translation" of climate and water information into likely sectoral outcomes of adaptation decisions, (ii) understand and implement appropriate processes for sustained dialog with stakeholders, and (iii) strengthen the capacity of policy- and decision-makers at multiple levels (national, regional, local, individual) to understand and use climate information and services in support of adaptation [73].

Outcome 3 will focus on the implementation, monitoring and evaluation of the use of climate services to inform specific adaptation actions in climate-sensitive sectors and vulnerable communities. Towards this goal, the end-to-end system to achieve production, dissemination and use of climate and water information and services will be tested in various demonstration sites and sectors throughout the ENANDES region (see Section 3.3). Communities and key actors in each demonstration site will help co-design and implement context-appropriate actions to enable adaptation to the local impacts of climatic hazards. These demonstration actions will test real-world adaptation pathways and will help build social capital and trust.

As part of *Outcome 4,* all of the insights, good practices, and lessons learned during Outcomes 1-3 will subsequently be transferred for replication or scale-up to other contexts in western South America and other countries in South America. The activities of Outcome 4 also are designed to strengthen the regional

coordination role of the Centro Internacional para la Investigación del Fenómeno El Niño (CIIFEN) – the institution designated by WMO as the Regional Climate Center for Western South America (RCC-WSA). CIIFEN/RCC-WSA will work closely with ENANDES NMHSs to coordinate a sustained capacity building strategy, facilitate access to global climate products, and support the functioning of technical working groups of regional experts. Moreover, CIIFEN/RCC-WSA will work with ENANDES countries to build partnerships, within or outside the region, to ensure the economic and institutional sustainability of ENANDES activities.

1.3 Project Goals and Objectives

The first overarching goal of ENANDES is to enhance the capacity of society and communities in Chile, Colombia and Peru to adapt to a varying and changing climate and contribute to reducing the associated disaster risks. Climate variability and change, growing economies and increasing urbanization pose systemic risks to agricultural, water and energy security everywhere [1-9]. Decision makers at multiple levels – households, communities, regions and countries – will need actionable scientific evidence and information to adapt to the multi-dimensional challenges and opportunities posed by climate variability and change and reduce associated risks and negative impacts. Two specific objectives are directly related to this goal:

- To strengthen the capacities of NMHSs in Chile, Colombia and Peru to produce and communicate sector-tailored climate and water information and knowledge to assist adaptation and decision-making; and
- To ensure completeness of the value chain of climate services through partnerships with experts from the target sectors and communities, and through the development and use of tools and processes that add value to climate information, and help translate climate/water information into actionable advisories or policies.

The second overarching goal of ENANDES is to boost the resilience of communities to climatic hazards by empowering local actors and institutions to mitigate the impacts of extreme weather, climate variability and change through co-creation, implementation and assessment of context-appropriate local adaptation practices. Global and national perspectives currently dominate policy discussions about climate, water, energy and food [74]. Nevertheless, it is still unclear how *global* trends will influence *local impacts and vulnerabilities* in an uncertain future: local contexts can strongly constrain adaptive capacity and ultimately modulate the potential impacts of extreme weather and climate in a region. Moreover, *most adaptation decisions and actions will occur at local scales.* Consequently, to design effective actions to manage the risks and mitigate the impacts of climatic hazards, it is imperative to understand local contexts (ecological and social) and culturally-filtered perceptions, that may impede or facilitate local adaptation [75, 76]. Preparedness and coping practices created through the engagement and ownership of people and institutions with local authority and responsibility work best when both the problems and possible solutions are local and acutely felt, as is the case with climatic hazards [15, 77]. The specific objectives associated with this goal are:

- To co-create, implement and assess context-appropriate local adaptation practices.
- To strengthen regional and local coordination, preparedness and adaptation practices against climatic hazards.

The third overarching goal of ENANDES is to enhance coordination and planning among institutions in participating countries to maximize positive synergies and increase the project's economic efficiency, ultimately facilitating replication and scale-up in other contexts. The specific objective associated with this goal is:

- To improve the regional capacity to produce relevant climate services through (i) active coordination and cooperation across a broad network of international, national and local institutions, (ii) pursuit of synergies with complementary climate-related projects in western South America and (iii) active capacity-building programs targeting not only ENANDES countries but South America at large.

1.4 Socio-Economic Sectors Targeted by Project ENANDES

Table 1. List of priority sectors for adaptation to climate change considered in the NAPs and NDCs for Colombia, Peru and Chile.

Sector	Chile	Colombia	Peru
Water resources	•	•	•
Agriculture	•	•	•
Energy	•	•	•
Forestry	•		•
Fisheries	•		•
Health	•		•
Environment	•	•	
Regional planning		•	
Education		•	
Institutional capacities		•	
Risk management		•	
Cities	•		
Tourism	•		
Industry			•

Chile, Colombia, and Peru have committed to limit the impacts of climate change through national plans (see details below for each country) where the governments' priority actions by sectors are outlined. The proposed adaptation measures provide the most vulnerable sectors with tools and support to reduce the impacts generated by extreme weather events and hazards associated with climate variability and change, as well as to take advantage of positive outcomes in favor of sustainable development. Moreover, the UNFCCC Paris agreement established in 2015, requested signatory countries to present Nationally Determined Contributions (NDCs) for both adaptation and mitigation. These documents expressed the determination of the ENANDES countries to ensure an effective response to climate change. Through ENANDES, the countries expect to translate this determination into concrete action. Because of the broad diversity of climate-affected decisions and decision makers, it may be useful to organize climate services around constituencies or sectors [78]. The sectors identified as NDC priorities by each country are listed in Table 1: *all three of the climate-sensitive sectors considered in this project (agriculture and water resource management) are priorities for participating countries.* Multiple reasons justify the choice of the three sectors to be targeted by ENANDES: agriculture, water and energy.

Agriculture. Clearly, agriculture is the human activity most dependent on climate and has the most extended land use by humans [46, 79, 80]. The rate at which crop yields are growing is already seriously lagging behind what is required to feed a growing global population, and the impacts of climate change pose a major risk to global food security and human development [81]. Among the countries that have signed the Paris agreement, 71 percent include adaptation goals and activities in their nationally determined contributions and 91 percent include agriculture as an adaptation priority [81]. The impacts of climate variability and change directly affect already vulnerable rural populations. For ENANDES countries, agriculture is not the major contributor to GDP: its contribution ranges between 3-6% of GDP, which is smaller than for countries such as Bolivia and Paraguay, where this sector accounts for 13-21% of GDP (Rabobank 2015). Chile, Colombia and Peru are, respectively the fourth, seventh and sixth largest exporters of agricultural commodities in Latin America (Rabobank 2015). In all three ENANDES countries, however, agricultural production is an important source of employment (Table 2).

Table 2. Contributions of agricultural production to the economies of ENANDES countries, 2012-2014 average. Source: Rabobank, 2015.

Economic contribution of agriculture	Chile	Colombia	Peru
Percentage of GDP	3.4	6.1	5.3
Percentage of jobs	13.0	15.0	24.0
Percentage of exports	25.0	12.0	19.0

Water. Disruptions to the hydrological cycle and hence water resources will likely be one of the primary consequences of early climate change. Given the critical importance of water to virtually all human activities, such disruptions will affect sustainable development, jeopardize economic growth, and exacerbate poverty

through impacts on food production, sustainable energy, livelihoods and environmental services. Increased water related risks associated with changes in the frequency of extreme events, such as flash floods or landslides, will create further stresses. The availability of water is fundamental for the ENANDES region and adjacent countries: agricultural production of the region, from subsistence farming in the Andean highlands of Peru and Colombia to export-oriented production in central Chile, depends to a large extent on the accumulation of snow and ice in the Andes. As occurs throughout South America, water is unevenly distributed across geography. For example, the Peruvian Amazon basin holds 97.5% of the country's surface water, but only 30% of the national population [82]. Water also is unequally distributed in Chile. The country's average water availability is close to 54,000 m^3 hab^{-1} yr^{-1}, positioning Chile in the 20th rank globally. However, most of Chile's population lives in areas of arid and semiarid climates, where water availability is less than 1000 m^3 hab^{-1} yr^{-1} [83]. While Chile's Southern Lake Region experiences over 4000 mm yr^{-1} of rainfall, northern parts of the country may receive only 1 mm yr^{-1}. An interesting dimension of water within the ENANDES region is Chile's privatization of water rights, an action that has led to several disputes over water usage and distribution [83]. It is unclear whether the tradeable nature of water rights has been a successful market-based solution to water scarcity that could be scaled-up or, as argued by many, privatization has instead decreased the long-term ability of the system to adapt to changing climate by eliminating any centralized control [84].

Energy. In addition to irrigated agriculture, water has major importance for energy generation in the ENANDES region. Geography has bestowed this region with some of the best hydropower resources in the world. Mountain glaciers, steep alpine valleys and long rivers (except for Chile) offer ideal conditions for developing hydroelectricity. Nevertheless, climate change and variability (including *both* rainfall deficits and excesses) have serious implications for power generation capacity, management of peak supply and demand, and dam safety. Hydroelectric power is particularly important for all ENANDES countries. In Colombia, large hydropower facilities satisfy the primary electricity demand (≈65%) and gas/coal-fired plants contribute the rest (≈35%), with little contribution from renewables [85]. The limited mix of energy resources has created considerable vulnerability in the Colombian power system, particularly in extreme dry conditions such as during El Niño events. In Peru, about 50 % of electricity is produced by hydropower, however so far only ≈8% of the country's estimated hydropower resource of 70,000 MW has been utilized. Clearly, there is large untapped potential from this source: Peru's National Energy Plan 2014-2025 forecasts that growth in energy demand (4.5 to 6.5 %) will be satisfied mainly by hydropower [86]. Hydroelectric power plants currently account for ≈40% of the installed generating capacity in Chile. Economic growth triggered an increase in the number of gas- and coal-powered thermal plants. Nevertheless, Chile lacks domestic fossil fuel reserves, and must rely on imported fuels for generation, leading to some of the highest electricity prices in the region. Consequently, Chile has focused much effort on developing solar and wind energy resources, for example in the Atacama Desert, home to some of the best solar resources the world [87].

2 Why Are Climate Services Needed?

Increasing awareness of the central role that climate plays in human welfare so far has not been matched with a corresponding ability to use climate information and knowledge for adaptation to climate variability and change, and for mitigation of their impacts on natural systems and human communities [66]. Consequently, there are active efforts to enhance the provision of "climate services" at international, regional and national levels [42, 63-68]. Climate services involve the timely production, translation, and delivery of climate data, information and knowledge for societal decision making [78]. These services are intended to facilitate both climate risk management and adaptation to climate variability and change, important challenges to sustainable development [42].

The Global Framework for Climate Services (GFCS) was established in 2009 within the UN System led by WMO, to guide the development and application of science-based climate information and services in

support of decision-making in climate sensitive sectors [42, 70]. As a partnership with broad participation and reach, the GFCS serves as a catalyzer for activities complementing existing programs and initiatives that contribute to climate services, building on existing capacities and potentials, and providing momentum and tangible progress towards this fast-growing field. As such, it is directly contributing to the achievement of global and national goals identified in evolving international policy frameworks, such as the Paris Agreement adopted under the UNFCCC in 2015, the UN's Sendai Framework for Disaster Risk Reduction 2015-2030, and the 2030 Agenda for Sustainable Development.

Figure 2. The five Global Framework for Climate Services components (inner ring) and priority areas (outer ring). Source: www.wmo.int/gfcs/about-gfcs.

The GFCS focuses on developing and delivering services in priority areas that present immediate opportunities to bring benefits and wellbeing: (i) agriculture and food security, (ii) disaster risk reduction, (iii) energy, (iv) human health, and (v) water. These priority areas were chosen because they are highly sensitive to climate fluctuations and also because they are sectors in which adaptation and mitigation strategies are critically needed. Figure 2 illustrates GFCS priority areas and components. *Three of these sectors (agriculture, water and energy) are directly targeted by ENANDES.*

Five GFCS components were identified as critical to address the entire value chain for the production, delivery and use of climate information and services [42]. As discussed in detail below, all five GFCS components are at least partly addressed by the proposed ENANDES activities. The GFCS includes five components listed below.

- *User Interface Platform:* a structured means for users, climate researchers and climate information providers to interact at all levels.
- *Climate Services Information System:* the mechanism through which information about climate (past, present and future) will be routinely collected and processed to generate products and services that inform often complex decision-making across a range of climate sensitive activities and enterprises.
- *Observations and Monitoring:* to ensure that climate observations and other data necessary to meet the needs of end users are collected, managed and disseminated and are supported by relevant metadata. The WMO Integrated Global Observing System (WIGOS) provides this component to the GFCS.
- *Research, Modeling and Prediction:* to foster research towards continually improving the scientific quality of climate information, providing an evidence base for the impacts of climate change and variability and for the cost-effectiveness of using climate information.
- *Capacity Development:* to address the capacity development requirements identified in the other components and, more broadly, the basic requirements for enabling any GFCS-related activity to occur.

Two of the GFCS components are highlighted not only because of their importance, but also because they are directly addressed as part of ENANDES proposed activities. The *Climate Services Information System (CSIS)* involves global, regional and national centers and other institutions that generate or process climate information and the exchange of data and products through existing internationally-agreed systems. Climate data includes past and present climate data (historical climate summaries, reanalysis and data rescue) as well as future climate (forecasts and projections) for use in mitigation, planning and adaptation. A key aim of the

CSIS is to enhance the capacity of national and regional centers for the effective use of global and regional inputs in national level operations. The Climate Services Toolkit (CST, www.wmo.int/cst), one of key instruments for CSIS implementation, promotes the development and provision of reliable, consistent and high-quality information and products to end-users. It will improve efficiency and raise capacities of service providers by facilitating the production, communication and application of climate information products.

The *User Interface Platform (UIP)* seeks to ensure that the information, products and communications relevant to user needs are actionable, timely, and easily understood. The User Interface Platform is the most novel GFCS component and reflects the fact that the involvement of users is crucial in helping to establish the needs, develop appropriate products, identify capacity development requirements and influence the direction of investments in observation and research efforts. UIPs foster interaction among users, user representatives, service providers and researchers, through regional climate outlook forums and other fora.

2.1 Current Situation of Climate Services in Western South America

A survey of the human and technological capacities of the NMHSs in western South America conducted as part of the baseline definition for the regional project PRASDES implemented by CIIFEN (www.prasdes-ciifen.org) identified the production of climate services as the greatest weakness of NMHSs from the region. NMHSs everywhere are increasingly being charged with providing climate services to diverse audiences; these organizations are viewed as naturally suited to be the central actors in climate service provision because of their expertise, institutional position and infrastructure [88]. However, the mandate places additional burdens on NMHSs and requires new skill sets, partnerships, and infrastructure. There are long-standing reasons that impede production of climate services by NMHSs: chronic personnel and budget shortages, small incentives for staff development, weak ties to research (particularly from fields outside hydroclimate), and operational missions that take priority over other tasks (especially, still unfamiliar activities such as climate services).

A major impediment for climate service provision by NMHSs in South America is the lack of expertise related to the translation, transfer, and facilitation of the use of climate information. In particular, most NMHSs lack effective engagement mechanisms with information intermediaries and end users, thus hindering the sector-specific tailoring of climate information so that it is relevant and actionable. Because the approach to climate services must be problem-centric, expertise is needed not only on climate science, but also about the dynamics of the activities or sectors targeted. Knowledge should be available about sector-specific process models that link climate (observed or expected) with likely impacts; such models should allow the exploration of viable actions to mitigate negative impacts or capitalize on favorable conditions. Sectoral expertise often is lacking within NMHSs, which therefore must engage with professionals that complement the climate sciences [89]. Alternatively, partnerships with institutions and actors from climate-sensitive sectors – e.g. those engaged in the ENANDES project – must be developed *and nurtured.*

From the start of ENANDES planning, the NMHSs of Chile, Colombia and Peru have made a strong commitment to sustain an active collaboration and coordination among themselves. ENANDES-facilitated regional cooperation will provide a mechanism to address gaps and disparities in capabilities of NMHSs, facilitate sharing of experiences and learning, and draw on the respective strengths of each country. Additionally, the partnerships proposed in the framework of ENANDES include not only the NMHSs, but also the WMO and its affiliate institutions in the region, such as the two WMO Regional Climate Centers in South America (covering western South America and southern South America, respectively) and the WMO Iberoamerican Regional Training Centers. An important executing focal point contributing to the overall coordination and integration of activities will be the CIIFEN in Guayaquil, Ecuador, designated by WMO as the RCC-WSA that covers Venezuela, Colombia, Ecuador, Peru, Bolivia and Chile.

ENANDES also will need to design innovative mechanisms to attract private and NGO participation in climate services' provision. Special consideration will be given to the involvement of boundary institutions that bridge

the divide between information producers (scientists) and information users (policy- and decision-makers) enhancing and sustaining communication, translating technical and scientific information into more usable forms, and mediating conflicts that arise in the boundary spanning process [90, 91]. Interactions between producers and users through boundary organizations (e.g., farmer associations, agricultural cooperatives) facilitate the use of climate information, both by increasing producers and users' understanding of each other's perspectives and expectations, and by building trust between producers and information users [92].

2.2 Towards National Frameworks for Climate Services

At the national level, the GFCS goals will be advanced by National Frameworks for Climate Services (NFCSs), the coordinating process to enable development and delivery of climate services at national level. ENANDES will yield real-world lessons that will guide the implementation of NFCSs – a goal of the three participating countries. An NFCS facilitates and strengthens coordination and collaboration among national institutions and key stakeholders, ensuring that the entire value chain for the production and use of climate services is addressed systematically and in a coordinated manner with the involvement of all relevant actors. A *"Step-by-Step Guideline for Establishing a National Framework for Climate Services"* has been produced by the GFCS Office [93].

NFCSs contribute to the implementation of the Paris Agreement. As of 2016, 66 out of 189 signatories of the Paris Agreement used climate services terminology in their NDCs [94]. Further, NFCSs and National Adaptation Plans (NAPs) for medium- and long-term adaptation to climate impacts complement each other. NAPs foster the establishment of institutional processes, governance structures, stakeholder platforms, and financial mechanisms where NFCS can plug in. In turn, various NAP elements require effective and timely climate services such as (i) assessment of climate vulnerabilities, (ii) identification of adaptation options, (iii) development of products that help improve understanding of climate and its impacts, and (iv) enhancement of capacity for planning and implementation of adaptation in climate-sensitive sectors. By supporting the NFCS process and its linkages to NAPs, ENANDES is well aligned with the international climate adaption policy agenda.

At a strategic level, NFCSs are essential mechanisms for the development of capacities as part of the Global Weather Enterprise. The Green Climate Fund (GCF) has recognized an NFCS as an essential element for the implementation of projects submitted to the Fund: the GCF is requesting compliance with the GFCS implementation plan on proposals that address development and application of weather and climate services. Other key funders, e.g., the World Bank, also are integrating NFCSs into their investment activities.

Countries can derive many benefits from the NFCS process. The benefit most frequently identified in a recent survey [95] was "increased collaboration between national meteorological services, national ministries, and other organizations." Other highly cited benefits included the "increased information sharing among participating organizations" and "elevated the importance of climate services and adaptation in national development agendas."

Table 3 lists the priorities related to the GFCS (left column) and the current status of the NFCS process in the ENANDES countries. Colombia is the only country in South America that formally launched in November 2017 the process to formulate an NFCS. The Instituto de Hidrología, Meteorología y Estudios Ambientales (IDEAM) – the focal point of ENANDES in Colombia – is working to improve the production of climate/water information and co-produce specific services for productive sectors of the country. In addition, the Dirección de Meteorología de Chile (DMC) and Peru's Servicio Nacional de Meteorología e Hidrología (SENAMHI) already have requested assistance from WMO to implement the GFCS in those countries.

Table 3. National priorities related to the Global Framework for Climate Services and updated status of the implementation of National Frameworks for Climate Services in Chile, Colombia and Peru.

CHILE	
GFCS Priorities	**NFCS Implementation Status**
Disaster Risk Management: large social and economic impacts in disaster-prone country. Agriculture: key economic sector for the country's GDP and exports. Water resources: availability and access to water is inextricably linked to other important activities (agriculture, energy) and is clearly sensitive to climate variability and change. Energy: the country is seeking to diversify its energy matrix through innovative renewable sources (solar and wind generation). Health: Interdisciplinary work on this issue has recently started, yet there is a need for greater interaction among relevant sectors.	Internal consultations to inform an NFCS started in 2018. Information gathering is still taking place as part of activities to define a national baseline. DMC is assessing its operational capabilities to respond to the NFCS implementation challenges, beginning with the agriculture sector. The identification and mapping of key stakeholders will begin in 2019 in order to identify intermediate and final users, as well as key strategic partners in the priority sectors.

COLOMBIA	
GFCS Priorities	**NFCS Implementation Status**
The ultimate goal of Colombia's National Plan of Adaptation to Climate Change is to reduce risks and socioeconomic impacts linked to climate variability and change. This goal requires the coordination of human, technological and economic resources to enhance the quality of climate information, its availability, accessibility and use, so this information can support climatically smart decisions in different national contexts (http://www.ideam.gov.co/documents/21021/71700061/Marco+Institucional_ServiciosClimaticosSectorAgro.pdf/47d6d39a-8702-40e0-82a5-98a07549c483). The Climate Change Law of 2018 seeks to foster coordinated actions to mitigate the emission of greenhouse gases, as well as adapt to change. The Law seeks development of guidelines to reduce the vulnerability of the Colombian population and the country's diverse ecosystems. The Law also created the National Information System about Climate Change, which will include transparent and consistent data and information to support decision- and policy-making http://es.presidencia.gov.co/normativa/normativa/LEY%201931%20DEL%2027%20DE%20JULIO%20DE%202018.pdf. The National Development Plan 2018-2022 highlights the priority of access to relevant and available information to inform interventions aimed at reducing climate-related risks and foster increased resilience (https://colaboracion.dnp.gov.co/CDT/Prensa/PND-2018-2022.pdf). The Development Plan includes a mandate for the Ministry of Agriculture and Rural Development (MADR) to develop integrated management of water resources and land use plans based on hydrometeorological information.	IDEAM initiated the implementation of Colombia's NFCS in November 2017, following the guidelines of the GFCS. A first stage involved a National Consultation held in September-October 2017 and a comprehensive identification of institutional actors that are both providers and users of climate services, their interests and needs, strengths and weaknesses, sectoral priorities and the key elements of climate information value chains. During 2018, several activities have taken place: • Development of an institutional and legal framework for climate services targeting the agriculture sector. • A document with a diagnostic of the state of the art in climate services for agriculture. • A deeper analysis of information requirements by farmers and associations was focused on needs of individual farmers and commodity groups. The exercise showed the need to understand even more the perspectives of the entire suite of agricultural users: rural communities, technical advisors and individual farmers. Regarding the human health priority area of the GFCS, an agreement has been signed between IDEAM, the National Institute of Health and the Ministry of Public Health. An information bulletin is being produced that discusses links between weather/climate and human diseases and disease vectors. There has been recent progress on characterizing climate conditions that favor the spread of dengue fever. In the energy priority area, IDEAM has been providing climate diagnostics and outlooks to the Ministry of Mines and Energy and the National Operations Committee, the forum where public and private sectors meet to address energy issues.

Colombia is developing an information system to manage agricultural risks (Sistema de Información para la Gestión del Riesgo Agropecuario, SIGRA). The characterization of climatic hazards for SIGRA will be undertaken by IDEAM. Colombia's NDCs include a strengthening of the capacities of the agricultural sector to adapt to climate variability and change. The contributions include specific actions such as the implementation of Mesas Técnicas Agroclimáticas (MTAs) – one of the adaptation actions proposed by ENANDES. Similarly, a goal is to reach one million Colombian farmers with agroclimatic information to support decision making. The order of GFCS priority areas was ranked as follows: (1) Agriculture and food security, (2) Water resources, (3) Health, (4) Climate Risk Management, and (5) Energy.	During 2019, IDEAM is expected to develop an Operations Plan for a NFCS.

PERU	
GFCS Priorities	**NFCS Implementation Status**
The Government of Peru has implemented a multi-sectoral technical working group (Grupo de Trabajo Técnico Multisectorial, GTM) through Resolution RSN 005-2016-MINAM. The Group has recently completed its task by developing a document describing 91 specific adaptation actions. The actions include specific goals and objectives to reduce vulnerability to the impacts of climate change in five important sectors: (i) agricultural production, (ii) forest resources, (iii) fisheries and aquaculture, (iv) human health and (v) water resources. The adaptation plan considers transversal approaches such as gender and intercultural perspectives. The Programa Presupuestal 068 "Gestión del Riesgo y Reducción de la Vulnerabilidad" is an item in Peru's national budget that includes vulnerability reduction and emergency attention for disaster risk management. Adaptation actions are expected to be gradually incorporated into different budget lines, giving them steady support and ensuring the sustainability of these actions. The multi-sectoral program for frost (PMHF) guides institutional actions to cope with low temperature events, from national levels to vulnerable districts. The SDG-6 monitoring project (GEMI) recommends multi-sectorial and progressive evaluations to elicit data to calculate indicators related to the strengthening of public policies. Peru is seeking to join the OECD – a program towards that goal was launched in 2014. The program is focusing on economic growth, governance, the fight against corruption, productivity and human capital and environment. Within this program, Peru is implementing actions to respond to the challenges of climate change by enhancing the management of water resources, improving air quality, and strengthening agricultural research and extension. National policies related to GFCS priorities are: promotion of food safety, sustainable development and environment management, science and technology development and agricultural and rural development policies.	The Ministry of Environment (MINAM) is beginning coordination with WMO to support the NFCS process. Peru is a member of WMO's Expert Team for the NFCS. Based on the CLIMANDES experience (funded by Swiss cooperation) preliminary mapping of stakeholders has been completed. National Climate Outlook Fora (NCOF) are being institutionalized as an interaction space to help users understand the limitations of available climate information, and to allow producers of info to assess users' needs and expectations and their decision-making processes. The National System for Disaster Risk Reduction (SINAGERED) connects all actors in the Disaster Risk Management (DRM) area. This platform is an inter-institutional, dynamic, decentralized, transversal and participatory system created in 2011 through Law #29664. The main objective is to identify and reduce risks related to multiple sources

3 The Area for Study

3.1 Geographic and Climatic Context of the Region

Chile, Colombia and Peru share the presence and influence on their climate of the Andes that run continuously near the western coast of South America for over 7000 km, from Colombia to the extreme south of Chile. The Andes have an average altitude of around 4000 meters above sea level (m.a.s.l.) and the highest peaks reach almost 7000 m.a.s.l. Despite their considerable altitude, the Andes are relatively narrow (< 200 km), except at subtropical latitudes, where the chain splits into two mountain ranges and contain the South American Altiplano, an elongated, high level (4000 m.a.s.l.) plateau, second only to the Tibetan Plateau in area and altitude [96]. The impressive length, continuity and height of the Andes create a variety of climatic and environmental conditions. Between 5-30°S (tropical and subtropical latitudes), relatively cold and arid conditions prevail along the Pacific coast extending well into the Andes western slopes, whereas warm, moist and rainy conditions prevail over the eastern slopes. This gradient reverses south of 35°S, with temperate rainy forests along southern Chile and precipitation maxima over the western slope of the Andes, whereas semiarid conditions are present to the east, leading to the temperate steppes of Argentina's Patagonia.

The climate of the ENANDES countries region is subjected to diverse influences: humidity transport from the Amazon forest to the east, the displacement of the Inter-Tropical Convergence Zone (ITCZ), the Bolivian High and the Trade Winds to the north. At higher elevations, the subtropical jet stream and the permanent high-pressure systems of the South Pacific and South Atlantic are also important [96-100]. The ENSO phenomenon, an interaction between the atmosphere and ocean in the tropical Pacific that results in a somewhat periodic variation between below-normal and above-normal sea surface temperatures and dry and wet conditions, is the major source of year to year climate variations worldwide [72, 101-105]. ENSO has profound effects on Western South America's (WSA) climate and societies, as the phenomenon is associated with droughts, floods, and other extreme weather events across the region [106-108]. The occurrence of the extreme phases of ENSO – El Niño and La Niña events – influences temporal and spatial distributions of precipitation, cloud cover and wind patterns in WSA, with significant socio-economic consequences on food production (including crops and fisheries), power generation and natural disasters [85, 108-112].

The availability of water is fundamental for the ENANDES region and adjacent areas, as the Andes feed the majority of South American watersheds. The hydrological cycle of the region depends on services from ecosystems found around and above 4000 m.a.s.l. (páramos, wetlands and glaciers). In these zones, water is absorbed and stored in solid and liquid form within the mountains and it is then released regularly throughout the year, feeding the majority of rivers in the region. Those rivers provide water to irrigated agriculture, sustain hydropower generation, and supply major cities in the region such as Bogotá (2600 m.a.s.l.), Lima (at sea level) and La Paz (4000 m.a.s.l.).

3.2 National Contexts

3.2.1 Chile

Chile has a land area of 755,915 km^2 in continental South America. The political-administrative organization is structured into three levels, with the largest areas being defined as regions, then provinces, and finally communes. The 2017 population was ≈17,575,000 (www.censo2017.cl), with the majority of the population concentrated in the central region, the Metropolitan Region of Santiago, where the country's capital is located. The economy is stable and has grown steadily during the last couple of decades: the country's GDP tripled between 1990 and 2015. The main economic activities are mining and agricultural production; these sectors account for a significant proportion of the country's total exports.

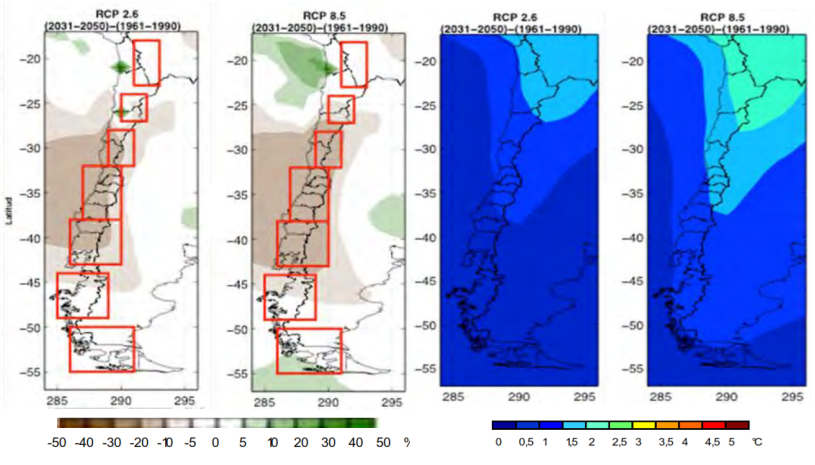
Climate. Chile extends from the tropics down almost to Antarctica. Its wide range of latitudes and the large elevation changes over short distances associated with the steep topography create a wide variety of climate

conditions. The most important factors that control the climate of Chile are the Pacific Anticyclone, the southern circumpolar low pressure area, the cold Humboldt Current, and the Andes Mountains. The northern portion of the country experiences very hot and arid conditions. Central Chile shows a Mediterranean climate with cool, wet winters. In the southern part of the country, the weather is cold and wet most of the year. Annual rainfall ranges from next to nil on the north – the Atacama Desert is among the world's driest regions – to about 500-1000 mm in south-central Chile, and to more than 4000 mm in parts of the south [113].

Recent and Projected Climate Trends. The main trend in average temperature up to 2010 has been an increase in temperature in the central valleys of the country, and cooler temperatures in the coastal region, which coincides with a cooling of the Sea Surface Temperature (SST) off Chile [114]. The frequency of hot nights has increased significantly since 1960 in every season. In the last century, changes in precipitation have shown important inter-decadal and inter-annual variability associated with the Pacific Decadal Oscillation (PDO) and El Niño-Southern Oscillation (ENSO) phases, respectively [115, 116]. The warm phase of ENSO (El Niño events) is usually associated with above-normal precipitation, whereas during the cold phase (La Niña events) precipitation tends to be below normal [101, 117]. The warm PDO-phase is associated with increased precipitation, while the opposite occurs during the cold PDO-phase [118]. Changes occurring at interannual and decadal time scales are superimposed on a long-term precipitation decline during the 20th century. A major highlight of recent climate has been the so-called "Chile Megadrought": a sequence of dry years uninterrupted since 2010 with annual rainfall deficits from 25 to 45% in central Chile [119, 120]. The precipitation deficit reduced the Andean snowpack and triggered significant declines (of up to 90%) in streamflow, reservoir volumes and groundwater levels [120]. On climate change scales, a study by the Univ. of Chile projected changes in the country's climate under two extreme Representative Concentration Pathways developed by the Intergovernmental Panel on Climate Change (IPCC): RCP2.6 and RCP8.5, the most and least favorable IPCC scenarios, respectively. Projections of mean annual rainfall are broadly consistent in indicating decreases in rainfall for Chile (Figure 3); annual projections vary between -5 to +2% by the 2090s. The projected decrease in rainfall is significantly higher in central Chile in all seasons [114]. The mean annual temperature is projected to increase by 0.8 to 1.9°C by the 2060s. The range of projections by the 2090s for any emissions' scenario is about 1°C. Warming is projected to be significantly higher in northern Chile than in central and southern Chile.

Vulnerability to Climate. According to the UNFCCC criteria, Chile is considered a country especially vulnerable to changes in climate, as it has a low coastal margin, a large area of its territory including archipelagos and islands, arid, semi-arid and forest-covered areas, and areas exposed to forest deterioration. In addition, it has areas prone to drought and desertification, urban areas with air pollution problems and fragile mountain ecosystems. Some regions in Chile are regularly affected by severe drought, where, on occasion, water shortages have been below 50% of average. Water resources in Chile depend largely on the accumulation of snow and ice in the Andes. For this reason, changes in precipitation or in the location of the 0°C isotherm from warming

Figure 3. CMIP5 precipitation and temperature projections in Chile for two IPCC scenarios (RCP 2.6 and 8.5) for 2031-2050. Left: projected percent changes in precipitation. Right: projected temperature changes. Source: Ministerio del Medio Ambiente, Chile.



may have an impact on the availability of streamflow in snowmelt-driven rivers. Climate change is also accelerating the progressive retreat of the tropical glaciers in the Andean region, which provides water for drinking, for small farms, hydroelectric power generation, and transnational mining operations. In the past 30 years, the glaciers have lost over 30% of their ice and snow, which will lead to severe water shortages in the future [121]. This prospect is concerning, as precipitation decreases and temperature increases will reduce water availability and trigger an earlier snowmelt, both of which would make the dry season longer and intense. These effects will continue to negatively impact various economic sectors in Chile, especially agriculture. Under these conditions, forest fires are likely to increase, both in frequency and in extension. Nevertheless, water demand will continue to grow in response to economic growth and social development. Consequently, a major challenge ahead will be to ensure water security for all Chileans while, at the same time, allow sustainable economic development [122].

Institutional Responses to Climate Variability and Change. Chile has addressed the issue of climate change through multiple actions and institutions. The Chilean Ministry of the Environment (Ministerio del Medio Ambiente, MMA) was created in 2010 through Law 20.417, which modified the earlier Law 19,300 ("Ley de Bases del Medio Ambiente"). The MMA is tasked with developing policies and formulating programs and action plans regarding climate change. The MMA, however, consults with other Ministries through the Council of Ministers for Sustainability and Climate Change. In 2008, the Chilean Government adopted the first "Plan de Acción Nacional de Cambio Climático" or PANCC-I as the strategic guideline for policy planning and implementation with respect to climate adaptation and mitigation issues. The PANCC mandated the preparation of a National Adaptation Plan (Plan Nacional de Adaptación al Cambio Climático) to articulate Chilean responses to climate change. Subsequently, sectoral adaptation plans have been developed for activities sensitive to climate (agriculture and forestry, biodiversity, fisheries and aquaculture, and human health) and other sectors are being addressed at present. The first PANCC (2008-2012) resulted in substantially enhanced scientific evidence that informed the PANCC-II (2017-2022). The PANCC-II is expected to provide the institutional framework through which sectors, regions and communities can coordinate and harmonize their respective climate-related actions. As part of the PANCC-II activities, the DMC (ENANDES focal point for Chile) is tasked with maintaining a network of weather stations to observe key weather variables, compute useful indices and indicators from those observations, and create plausible climate change scenarios for impact assessment.

3.2.2 Colombia

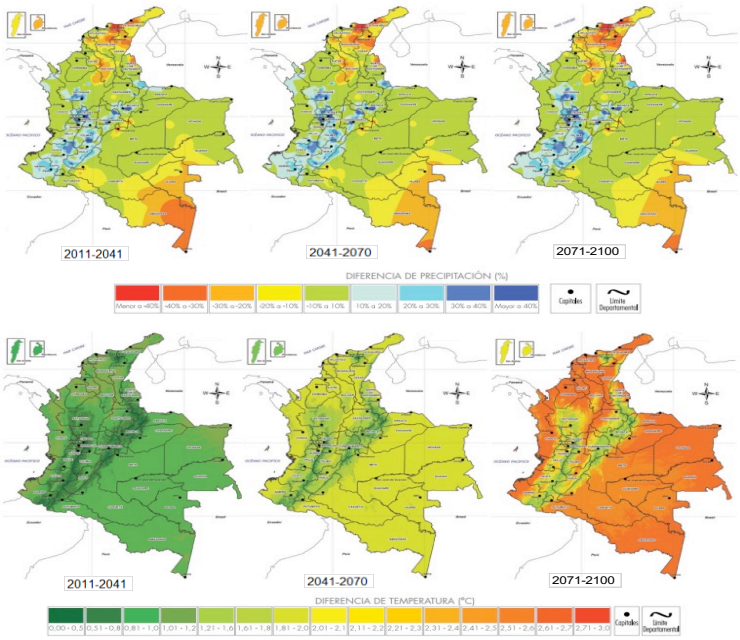
Colombia has a land area of 1,141,748 km^2 in continental South America. The political-administrative organization is structured into 32 departments and a capital district. The 2018 population was estimated to be ≈48,169,000 [123].

Climate. At latitudes of 4°S to 12°N Colombia's climate is typically tropical, marked by year-round wet weather. Being close to the Equator, the low coastal areas of Colombia show high temperatures (25-30°C) and high humidity, with little variation throughout the year. Annual rainfall ranges between less than 500 mm yr^{-1} in the Guajira region to over 9000 mm yr^{-1} on parts of the Pacific coast. Rainfall is heaviest on the west coast and in the Andean region. The greatest single influence on the annual cycle is the meridional migration of the ITCZ and its pattern of associated trade winds [124, 125]. The ITZC displacement results in a bimodal annual cycle of rainfall in western and Central Colombia. All months are wet, with the first peak in rainfall around April-May and a second peak occurring in October-November [126]. The ENSO phenomenon is the greatest single cause of interannual variability [107, 125]. El Niño events bring warmer and drier than average conditions during the last portion of the wet season (October-November), whereas La Niña events are tied to colder and wetter conditions at that time [107, 124].

Recent and Projected Climate Trends. The frequency of hot days and hot nights has increased significantly since 1960 in every season. The frequency of cold days and cold nights has also increased noticeably since 1960 in every season [126]. Climate change scenarios project rainfall reductions of up to 40% in the

southeastern regions and in the northern Caribbean region, while an increase by up to 40% is projected for the Andean region and the Pacific coast. For air temperature projections indicate increases in values ranging from 0.5-1.0°C in the average period to 2040, and up to 3.0°C in the period to 2100 (Figure 4, [127]).

Figure 4. Projections of climate change for Colombia (average for all Representative Concentration Pathways scenarios, RCPs). Columns show projections for 2011-2041 (left), 2041-2070 (center) and 2071-2100 (right) periods. Top row: percentage changes in precipitation. Bottom row: projected changes in temperature. Source: IDEAM et al., 2015.



Biodiversity. The biodiversity of Colombia is among the highest in the world: about 63,000 species have been recorded. The services provided by biodiverse ecosystems can be strongly affected by climate change. Colombia accounts for about 10% of the world's biodiversity, mostly because of the large area covered with natural forests (52% of the continental area). A little over half of the total forest area is located within indigenous population areas. Unfortunately, in recent years deforestation has increased as a result of the expansion of cropped and cattle areas, illegal crops and informal wood trade and mining. It is also important to note that Colombia has over 60 percent of the total global *páramo* area: these are cold high-altitude wetlands which generally are below any permanent snowline but above the altitude of continuous forest. The páramos' unique flora and fauna include giant rosette plants and a broad range of mammals, reptiles, birds, amphibians and insects not found in other ecosystems. Their role in sequestering carbon dioxide, as well as in filtering and purifying water in the upper reaches of watersheds, underlines their importance not only in terms of the hydrologic cycle, but also with respect to biodiversity, ecosystem health, and food security and nutrition.

Vulnerability to Climate. Colombia is highly sensitive to climate variability and change. The majority of the population lives in the elevated Andes, where water shortages and land instability are already a reality. Over the long-term, an increase of temperatures would result in an accelerate melting of glaciers [128] and decrease of snowfalls, as well as a retreat of the páramos in altitude. These two ecosystems provide important services such as water storage for the region, and thus contribute to agricultural productivity and hydroelectric production. The impacts of climate change will affect the quality of life of all Colombians, but will especially affect those living in rural areas. A good portion of the agro-ecosystems of the country is vulnerable to increased aridity, soil erosion, desertification, and changes in the hydrological system. Additionally, the projected lack of water will affect the already drought-sensitive hydroelectric sector, compromising the production of electricity in the area. Moreover, possible extreme precipitation would affect even harder those areas that are exposed to high risk events such as landslides and floods. Coastal populations are vulnerable to sea level rise and flood that may affect human settlements and tourism, a key sector for Colombia.

Institutional Responses to Climate Variability and Change. The lead institution for issues related to climate change is the Ministerio de Ambiente y Desarrollo Sostenible. This institution is in charge of coordinating the Plan Nacional de Adaptación al Cambio Climático (PNACC) that states the need to generate information and

evidence to assess climate risks. The PNACC also seeks the strengthening of national capacities to plan and prepare for the hazards of climate variability and change. The 2017 Política Nacional de Cambio Climático (PNCC) sets as strategic goals the achievement of rural and urban development with low carbon footprints and resilient to climate variability and change. Finally, Colombia's Plan Nacional de Desarrollo 2018-2022 sets forth the need to enhance scientific evidence and knowledge about the threats, exposure, vulnerability and risks from natural and social-natural hazards.

3.2.3 Peru

Peru has a land area of ≈1,285,216 km^2 and is the third largest South American country after Brazil and Argentina. The political-administrative organization is structured into three levels: regional governments, provinces and districts. Peru has an extremely varied geography and topography. The Andes run longitudinally across Peru, dividing it into three major regions: the narrow desert strip along the South Pacific ("Costa"), the Andes highlands above 2000 m ("Sierra") and the tropical jungle ("Selva") east of the Andes.

The 2018 population of Peru was estimated to be ≈48,169,000 [123]. Recent population growth has been tied to significant increases in greenhouse gas emissions in response to increased demand for food, transportation, and electricity. The Costa is home to ≈55% of the Peruvian population, including the country's capital city of Lima. The rural Sierra accommodates less than 25% of Peru's population but accounts for 54% of the country's extreme poor. The Selva encompasses the largest portion (≈58%) of the country, yet is home to only 14% of the population.

In recent years, Peru has made significant improvements in social indicators such as poverty, education and health. Peru´s geological characteristics make it the seventh richest country in mineral resources such as copper, gold and silver. Mining, therefore, is a major source of foreign exchange earnings for the country. Other exports include natural gas and petroleum, agricultural commodities, fish oil and fishmeal.

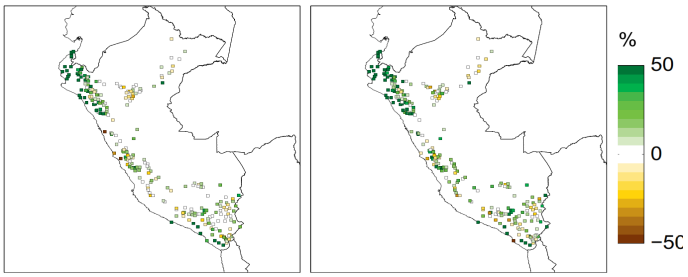
Climate. The climate of Peru is highly diverse: due to the complexity of its topography, the influence of the Humboldt Current and its location near the ITCZ, Peru covers 28 out of 32 climate zones. The northern rainforest is the region where highest rainfall values are observed. Precipitation is low along the coast, with seasonal increases between December and May. Rainfall is moderate in the Andean region, and has more pronounced seasonal variation, with a rainfall peak between December and May. The climate of the Andean region is strongly modulated by the altitudinal gradient along the cordillera. In the inter-Andean valleys at intermediate altitude (2500-3500 m.a.s.l.), annual average temperature varies between 11 and 16°C and precipitation ranges between 50 and 1000 mm yr^{-1}.

Recent and Projected Climate Trends. Precipitation has shown a decrease in recent decades, while both maximum and minimum temperatures have increased for the same period. The future climate scenarios indicate that climate change would affect precipitation in Peru with a high spatial variability, with both increasing and decreasing trends, even between nearby points. The exception would be in the northwest region of the country where the projections mark a definite increase in rainfall (Figure 5). On the other hand, air temperature would increase throughout Peru, with minimum temperatures increasing more than the maximum. The highest changes would be in the highlands, with temperature increases of up to 4°C (Figure 6).

Vulnerability to Climate. Peru is among the countries most vulnerable to climate variability and change. The country's high vulnerability is associated with the fact that Peru is one of the 16 mega-diverse countries in the world: it has the second largest Amazon forest after Brazil and the most extensive Andean mountain range in South America. Moreover, this country includes 84 out of 117 identified life zones in the planet. Additionally, Peru is South America's most water stressed nation. The country includes 71% of the world's tropical glaciers. Nevertheless, the retreat of mountain glaciers, caused by global warming, has a direct impact on present and future water availability. This scenario represents a serious threat to a country where precipitation is seasonal and often irregular, and where glaciers constitute a major source of freshwater

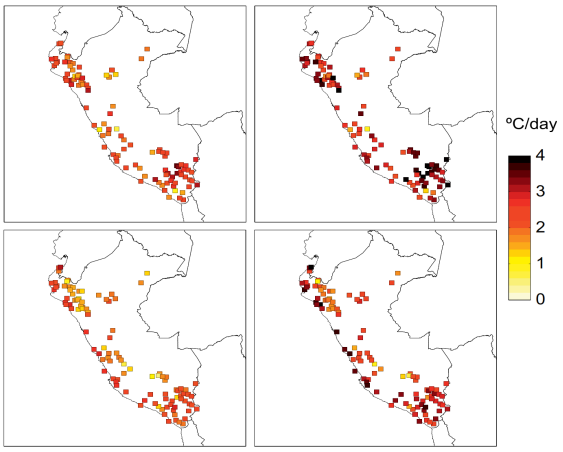
[129]. The disappearance of Peru's glaciers is particularly critical in the country's highlands, where agriculture and cattle raising rely on irrigation; water scarcity generates social conflicts in many places throughout this region [130]. The Peruvian Amazon basin – one of ENANDES demonstration adaptation sites – contains 97.5% of the country's surface water but only 30% of the population, which is mostly concentrated along rivers [82]. Fragile Andean ecosystems are particularly vulnerable to the adverse impacts of climate change, deforestation and forest degradation, land-use change, land degradation and natural disasters (including an increased frequency of fires). The high Andean plateau is one of the cradles of global agriculture: crops such as potato and quinoa were first domesticated there. High-impact weather events can lead to significant or even total crop losses, as well as endangered food security. Smallholder farmers often have limited options to adapt to, and cope with extreme weather or climatic changes. These limited options make the provision of climate services particularly relevant. About 53% of energy production in Peru is generated by hydropower plants that are highly vulnerable to climate fluctuations, yet there is a large potential for hydropower that is not being tapped. Renewable non-conventional sources account for only 1% of supply.

Figure 5. Precipitation changes projected for the 2036-2065 period for Representative Concentration Pathways 4.5 (left) and 8.5 (right). Source: MINAM Peru, (2016).



Institutional Responses to Climate Variability and Change. To address the societal and environmental challenges posed by climate variability and change on resources and communities, Peru developed a National Strategy on Climate Change in 2014. This framework guides government actions, including the fulfillment of Peru's commitments to the UNFCCC and advancing the national adaptation agenda. Nevertheless, adaptation and mitigation decisions by Peruvian authorities and by actors from multiple climate-sensitive sectors and human activities need to be based on authoritative, relevant and useful climate data, information and knowledge that expand alternatives and clarify choices for decision makers at the relevant scale and context [131]. A key milestone was the 17 April 2018 approval of Law 30754, the *"Ley Marco sobre Cambio Climático."* This law sets the principles, approaches and procedures to coordinate, articulate, design, execute, monitor, evaluate and communicate public policies for the integrated, participative and transparent management of adaptation and mitigation actions. Interestingly, the Framework Law specifically considers transparency, human rights and access to information, and intercultural principles. Nationally Determined Contributions (NDCs) are specific instruments to manage climate change risks in Peru – in addition to national and subnational strategies. Recently, the Ministry of the Environment has about 91 NDCs for different sectors of society. A consultation with government agencies in Lima in January 2019 showed that many of the adaptation NDCs align closely with proposed ENANDES activities.

Figure 6. Changes in maximum (top row) and minimum (bottom row) temperatures for the 2036-2065 period for RCP 4.5 (left) and 8.5 (right). Source: MINAM Peru (2016).



3.3 Background on Demonstration Adaptation Sites

The need for local perspectives. It is still unclear how *global* change drivers – including climate variability and change - will influence *local* impacts and vulnerabilities in an uncertain future [74]. This is a critical gap in knowledge, as most adaptation decisions and actions will occur at local

scales. Indeed, local contexts can strongly constrain adaptive capacity and ultimately modulate the potential impacts of extreme weather and climate in a region. *Therefore, it is crucial to understand how climate information and services can inform regional and local preparedness and adaptation practices in the face of evolving climate risks.*

Effective use of climate information and knowledge to support adaptation not only requires relevant and actionable information about climate trends and fluctuations and their likely sectoral impacts, but also a corresponding understanding of the local contexts that determine whether adaptation practices to manage risks and mitigate climate impacts on agriculture, water and energy are culturally appropriate and economically, environmentally and socially viable. Consequently, ENANDES will explore multiple real-world adaptation activities in various demonstration regions to gain first-hand experience about how to successfully combine actionable and relevant climate services with regional and local adaptation, coping and *ex-ante* preparedness practices created through the engagement of people and institutions with local authority and responsibility. The demonstration adaptation sites in each country include:

- Chile: (i) The Aconcagua River Basin in central Chile and (ii) the Chilean electricity sector from Arica to Chiloé.
- Colombia: (i) the Río de las Piedras Basin and (ii) the Los Cerrillos region, both in the Municipio of Popayán.
- Peru: (i) The middle and upper basins of the Rímac River near Lima, and (ii) the Huallaga River basin in the eastern slopes of the Andes and the "Selva" region.

Background on these demonstration sites, together with a justification of their selection for ENANDES is provided in the sections below.

3.3.1 Chile

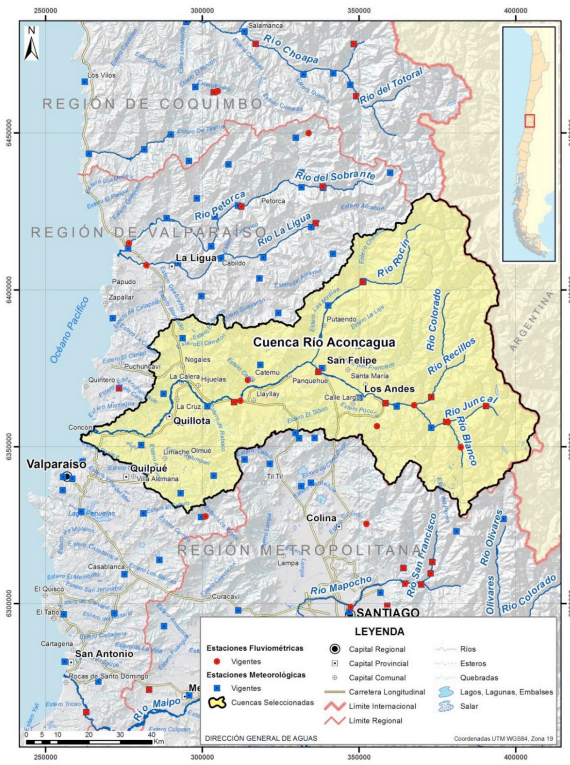
3.3.1.1 The Aconcagua River Basin

The first Chilean adaptation site is the Aconcagua River Basin (ARB). The region was chosen as a case study for understanding the impacts of climate variability and change on water demand and availability (i.e., decreasing precipitation and increasingly depleted snowpack and glaciers) for irrigated agriculture, and possible adaptation actions. The ARB is projected to undergo decreasing water availability. Conflicts already are emerging over unsatisfied water demand due to protracted drought and larger irrigated extensions. Finally, the ARB is the second most productive irrigated valley and is located in central Chile, where most of the country's population lives.

The ARB encompasses 7333 km^2 within the Valparaíso Region (Figure 7). The Aconcagua River is 215 km long, from the Andes to the Pacific Ocean [132]. The basin elevation ranges from sea level to 6,100 m and borders Mt. Aconcagua in Argentina [133].

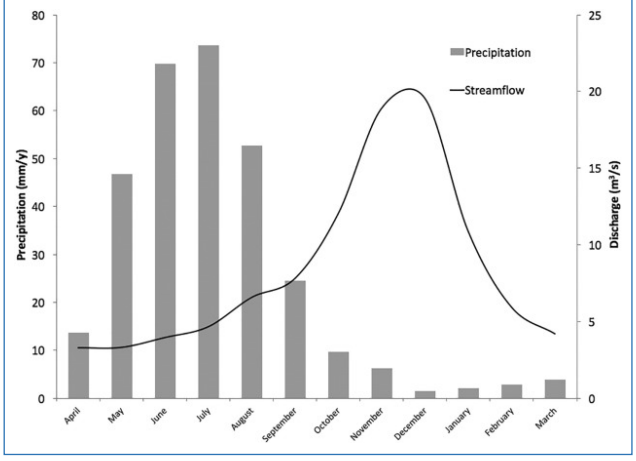
The ARB has a population of roughly 500,000. The basin includes the provinces of Quillota (mid-section of the Aconcagua River), San Felipe, Aconcagua, Los Andes and Valparaíso. Populated areas are mostly near the Aconcagua River: according to the 2002 Census,

Figure 7. The Aconcagua River Basin in the Valparaíso Region, central Chile. Blue squares indicate existing meteorological stations. Red circles indicate hydrometric stations. Source: Dirección Nacional de Aguas, Chile.



Quillota (75,916), San Felipe (64,126), Los Andes (60,198) and La Calera (49,503) were the main towns. Agriculture and mining are the main economic activities [84].

Figure 8. Monthly precipitation and streamflow for the Aconcagua River at Vilcuya station. 1941 to 2009. Source: Janke et al., 2017.



Streamflow in the ARB results from a mix of rainfall and meltwater (Figure 8). The upper and middle sub-basins depend strongly on meltwater, with a marked peak in flow during spring/summer (snowmelt during November-December, glacier-melt in February-March) [133]. Seasonal snowpack and glaciers store water for the dry season, when up to 67% of water is derived from meltwater [134]. In the lower portion of the ARB, in contrast, streamflow mostly depends on rainfall during the austral winter (May-September).

Since 2010, total annual precipitation in the ARB has averaged only 144 mm, whereas the historical average (1941-2009) was 307 mm; this represents a 53% decrease. Precipitation at individual stations in the ARB also show deficits that range from 45 to 83%. During spring and summer, when irrigation demand is high, ice- and snowmelt in the upper catchments provide most of the streamflow for the river basins. Previous studies in the Aconcagua Basin have inventoried glaciers and estimated glacier water storage [134] and investigated regional precipitation and discharge trends, especially related to ENSO [135].

For hydrological management, the ARB is divided into four administrative sections, plus the Putaendo sub-basin. The Third Section of the ARB (mid-basin) is where most adaptation activities will be focused. This section encompasses 48 km of the Aconcagua's length. The Third Section has one of the oldest "Juntas de Vigilancia" (groups monitoring that water rights are properly used), formed in the 1950s. The section has 16 channels for the irrigation of Quillota.

A large portion of agriculture in the Valparaíso Region is located in the Aconcagua Basin, the second most productive irrigated valley in the country [133]. About 557 km^2, or 7.6% of the ARB, is under cultivation, most of which is concentrated in the Putaendo and lower sub-basins. Table grapes (upper basin) and avocados (mid-basin) make up almost half of the cropped area in the ARB (Table 4). Smaller farms are becoming increasingly common within the ARB due, in part, to the increasing cost of land near urban areas that leads to smaller periurban farms to supply cities. At the same time, this area also includes small farms that originated as part of the "agrarian reform" process. There are several "áreas campesinas" within the ARB that are associated with bad irrigation infrastructure. These areas also have issues with poorly defined water rights.

Table 4. Total area under cultivation and irrigation requirements for the most prevalent crop types in the Aconcagua Basin. Combined, table grapes and avocados make up close to half of the total crop area in the basin. Source: Webb, 2018.

Crop	Cropped Area (ha)	Percent of cropped area	Water needs (m^3 ha^{-1})
Table grapes	14,111	25.2	8,788
Avocado	13,020	23.3	10,860
Alfalfa	5,461	9.8	30,299
Peach	3,972	7.1	12,918
Walnut	2,451	4.4	14,757
Orange	1,173	2.1	6,889
Tomato	1,113	2.0	12,358
Artichoke	1,096	2.0	14,856
Potato	1,072	1.9	4,775
Lemon	1,045	1.9	6,854
TOTALS	44,514	79.7	--

The main consumptive uses of the Aconcagua River are irrigation, domestic water usage, industry and mining. The Greater Valparaíso - Viña del Mar – the second largest metropolitan area in the country with about one million

inhabitants – and a large copper mine (Andina/Sur-Sur) located in the upper basin, also use water from the Aconcagua River. The main use of water within the ARB (> 80% of total) is agricultural irrigation [132]. Since 2000, the irrigated land in the Aconcagua Basin has increased by at least 15%. Between 1990 and 2012, total water demand (consumptive and non-consumptive uses) more than doubled in Valparaíso Region, from 61 to 152 $m^3 s^{-1}$.

The ARB is one of the few basins in Chile not regulated by a major dam, in part because the region historically had sufficient water resources and highly suitable climatic conditions for agricultural production. However, over-exploitation together with diminishing contribution from snow pack and glacier melt are reducing the natural storage capacity of the Andes, reversing this situation into one of hydrological deficit. As this happens, irrigators and water managers have increased their demands for the drought-prone Aconcagua River. *In conclusion, the intertwined effects of both climatic and non-climatic drivers are placing increasing pressure on the water resources of the Aconcagua basin. Heightened competition for water in agriculture, mining, and domestic purposes has led to increasing conflicts and requests for scientific evidence and interventions such as enhanced regulation and coordination processes [136].*

3.3.1.2 The Chilean Energy Sector

This second demonstration "site" in Chile is atypical, as it is not a geographic area as in other cases but, instead, targets almost all of the energy sector of Chile, from Arica to Chiloé. Because of the connectivity and interdependence of modern power infrastructure, any interventions based on weather or climate information in one place (e.g., extreme heat near Santiago) will have implications over most of the system, hence the integrative perspective.

Chilean energy demand has been growing rapidly (more than 7% annually) since 1992. This growth has come mostly from increased power demand by the mining sector, the country's largest industry, and by growing urban areas such as Santiago, which contains almost 40% of Chile's population. The increased demand, combined with scant fossil fuel resources, make Chile a net importer of energy. Hydroelectric power plants presently represent about 40% of the installed generating capacity of Chile, and, in 2000, provided about half of Chile's electricity. The largest hydroelectric facility is the 500 megawatt (MWe) Pangue Power Plant, located on the Bío-Bío River in central Chile. There are ten other hydroelectric facilities with at least 100 MWe capacities [137]. Energy installations are shown in Figure 9.

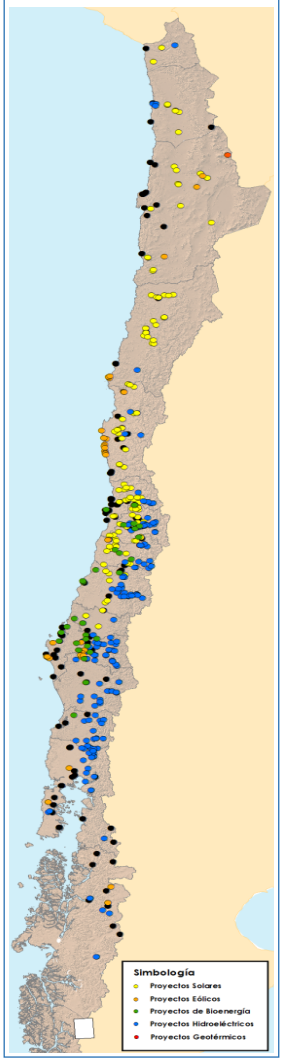


Figure 9. Energy projects in operation, undergoing tests and under construction in Chile. Source: Min. de Minas y Energía.

Chile's energy sector is largely privatized, particularly the electricity industry. In the electricity market, the areas of generation, transmission and distribution are separated. This implies that stakeholders from these separate segments may have different demands for climate information and services. The National Electric System in Chile is organized around four grid systems: 1) Sistema Interconectado del Norte Grande (SING), the northern grid (19% of total generation); 2) the Central Interconnected System (SIC), the central region's grid (68.5% of national generation) that serves 93% of Chile's population; and 3) the Aysén and 4) Magallanes grids in southern Chile, that together make up about 1.1% of total generation. Up to 2018, the main two grid systems – SING and SIC – were not physically connected. Once they were linked, the National Electricity Coordinator (NEC) had the opportunity to organize contributions from about 500 electricity generation units. An increasing share of renewable energies in the supply, together with climatic hazards such as persistence droughts and extreme high temperatures complicate the NEC's tasks. Meetings held with the NEC during proposal preparation identified specific opportunities to enhance this unit's operation through timely provision of relevant

weather and climate information, as proposed by ENANDES. These opportunities (together with needs from several other actors from the Chilean energy sector) are described as part of proposed adaptation activities (Section 5.3.2).

3.3.2 Colombia

The adaptation sites in Colombia are adjacent to each other and both located in the Municipio (Municipality) of Popayán, Department of Cauca. ENANDES will work on the Río Piedras Basin in the eastern part of the Municipio, and the area called Los Cerrillos in northwestern Popayán. These two areas will address smallholder agricultural production in an area that (i) is threatened by droughts and floods, and (ii) includes both indigenous populations (second largest indigenous population in Colombia) and peasant communities.

Popayán was chosen for several reasons. First, it has climate-sensitive environments such as *páramos* that provide important water-storage services, and climatic hazards such as floods and droughts which occur frequently. Second, the area includes indigenous populations and small farmers ("campesinos" or peasants). Popayán has witnessed multiple conflicts – mostly settled now – over land tenure among land owners, peasants and indigenous populations. To address these conflicts, small farmers grouped into associations (e.g., Asocampo and Asoproquintana) that are now useful boundary organizations for ENANDES interactions. Third, there is much background on this area. For instance, it has been the site of a joint Colombia - United Nations project ("Integración de Ecosistemas y Adaptación al Cambio Climático en el Macizo Colombiano"). Fourth, Popayán was among the earliest sites where the Mesas Técnicas Agroclimáticas were launched [131]; this adaptation action will be common to all ENANDES countries. The Mesas were supported by Colombia's Ministerio de Agricultura y Desarrollo Rural (a key ENANDES partner) and involved cooperation with the CGIAR Climate Change, Agriculture and Food Security (CCAFS) program. This site also participated in the Territorio Sostenible Adaptado al Clima (TeSAC) program by CCAFS, aimed at enhancing the capacities of small farmers to adapt to climate variability and change. Finally, ENANDES will partner with two Popayán NGOs: the Fundación Río Piedras – supported by the Empresa de Acueducto y Alcantarillado de Popayán, a public organization supported by the Municipality – and the Fundación Ecohabitats. Both NGOs have been active for several years and have strong credibility across the region.

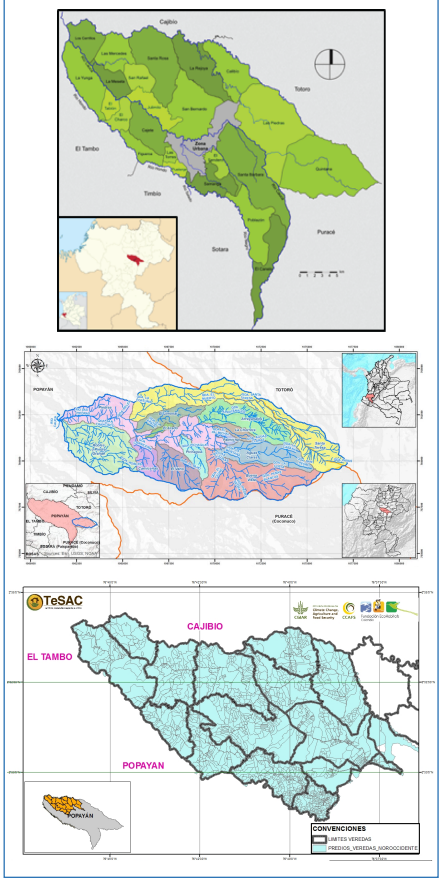


Figure 10. Top: the Municipio of Popayán, Colombia; the inset shows the location of Popayán within the Cauca Department. Middle: the Río Piedras Basin, source: Recamán Mejía, 2017. Bottom: The Los Cerrillos area in northwestern Popayán, source: Fundación Ecohabitats.

The Municipio of Popayán (Figure 10, top) encompasses about 483 km^2 and has an average altitude of 1737 m.a.s.l. Popayán includes two "resguardos indígenas," Quintana and Poblazón, and one indigenous population (Yanacona). According to the 2005 population census in Popayán, there were 7401 people self-identified as indigenous, 2822 of them living in rural areas. The same census counted 7541 Afro-Colombians in Popayán, although only 528 lived in rural areas. Campesino families occupied vacant lands or were assigned lands in which they were former tenants as a result of agrarian reformation. About 37% of rural inhabitants of Popayán have unsatisfied basic needs [138].

The Río Piedras Basin (RPB) is in the western side of the Cordillera Central (Figure 10, middle). The basin has an area of 58 km^2 and altitudes ranging between 1900 and 3800 m.a.s.l. The RPB is extremely important because of its water services: the RPB supplies drinking

water to the city of Popayán and to multiple irrigation channels throughout the basin [139]. Average annual rainfall in the RPB is about 1600 mm, but recently farmers have expressed concerns about occurrence of both very dry and extremely rainy years and intense precipitation events that trigger soil erosion and landslides [140]. Rainfall is concentrated in the October-May period (with intense rains in October-December), and a dry period in June-September.

Native vegetation in the RPB ranges between mountain rainforest in the *tierra templada* (up to ≈2000 m.a.s.l.), the "cloud forest" *(bosque nuboso)* in the *tierra fría* that encompasses the largest portion of the basin and is intensively used for cropping and cattle raising, and the páramo in the *tierra helada* (at ≈3200-4000 m.a.s.l.). The páramo has an enormous water holding capacity [140]. Dairy farming prevails in the RPB. Agriculture is mostly oriented to produce food for households, with small surpluses sold in local markets. The main crops include maize, vegetables, frijol, small amounts of potatoes, and coffee in the lower portions of the RPB [139]. The population includes indigenous families from the Páez ethnic group in the Quintana "resguardo", the Coconucos ethnic group in Puracé, and campesino families that occupied vacant lands.

The second demonstration site will be the region of Los Cerrillos, northwest of the city of Popayán in the sub-basin of Río Palacé (Figure 10, bottom). This area is associated with the so-called meseta (plateau) de Popayán (altitudinal range 1550-1770 m.a.s.l.). Despite being a high mountain environment like the RPB, Los Cerrillos is more prone to droughts, the main climatic hazard perceived by peasants according to the Fundación Ecohabitats.

The Popayán meseta and its surroundings are sheltered by the Andes, which create homogenous weather and altitude conditions that favor coffee production – the Café de Cauca is one of the most outstanding varieties in Colombia. Despite the favorable conditions, coffee production typically involves very small plots (< 1 ha) and low technology, resulting in low productivity. Another important crop is sugar cane or *caña panelera* to produce *panela*, unrefined brown sugar usually produced manually in small mills (or *trapiches*) and sold in solid blocks that can be scraped and chiseled off to use. Most households (61.5%) exploit farms between 1 and 5 ha, 26% of households crop less than 1 ha, and only 12% have farms > 5 ha (source: Fundación Ecohabitats). The strong focus on coffee and sugar cane makes the region highly vulnerable to climate and price risks. The limited availability of more profitable agricultural alternatives induces youth to migrate out of the farms; ENANDES will explore alternatives to keep youth involved in agriculture.

Very importantly for ENANDES, several activities related to adaptation to climate change and variability took place previously in Los Cerrillos, providing useful background and insights. For example, CCAFS and Fundación Ecohabitats (an ENANDES partner) collaborated in projects such as the Climate Smart Villages (CSVs) and the TeSACs mentioned above. The CSV approach is a research-to-development approach to test, through participatory methods, technological and institutional options for dealing with climate change in agriculture. It aims to generate evidence at local scales of what climate-smart agricultural options work best, where, why, and how, and use this evidence to draw out lessons for policy makers, agricultural development practitioners, and investors from local to global levels [141].

The TeSAC program created a baseline of farming households in Los Cerrillos [142]. At the time of the survey in late 2014 only 14% of farmers received climate information on extreme events at the start of the rainy season. Women were more likely than men to adopt climate-smart agricultural practices and to use climate information to plan agricultural and household activities. Both men and women in Los Cerrillos perceived changes in climate, namely higher frequency of drought and increased temperatures [138]. There was little formal government presence and few links with other organizations apart from the National Coffee Federation, which provides basic technical support to farmers. Other useful findings highlighted the empowerment role played by the "Juntas de Acción Comunal," nonprofit civil, social, communitarian, and neighborhood organizations.

Another example of community-based initiatives relevant to ENANDES is the *Iniciativa Custodios de Semillas* (Initiative for Seed Custodians), started by the Comité Regional Indígena del Cauca (CRIC). This initiative aims to ensure present and future food security and sovereignty in the face of climate change. The initiative involves the preservation and "custody" by several indigenous families of seeds (i.e., genotypes) from different varieties of crops that are exchanged among indigenous farmers. As stressed throughout the proposal, adaptive actions initiated in response to climate variability and change can lead to unplanned co-benefits that enhance livelihoods: for example, improvements in farming practices resulting from discussions held among farmers during Seed Custodians' meetings, or the allocation of space reserved to organic products in the Popayán city market.

3.3.3 Peru: Rímac and Huallaga Basins

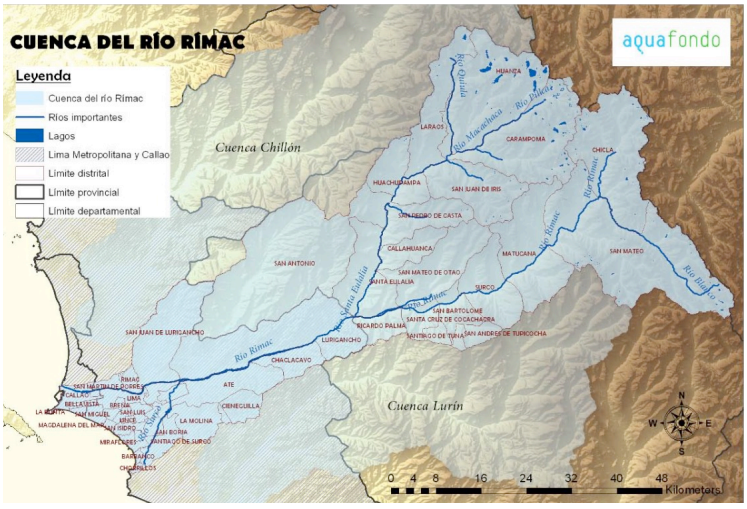
3.3.3.1 The Rímac River Basin

The Rímac watershed (Figure 11) is located in central Peru. The focus on this demonstration site is on providing climate services that inform management of water supply to a major city – with almost 9 million people, Metropolitan Lima is the world's second-largest desert city after Cairo [143]. A second focus will be on enhanced management of flooding and landslide risks that arise from the combination of increasingly frequent high-intensity rainfall events and precarious dwellings along the margins of the Rímac.

The Rímac River descends from an elevation of 5500 m to the Pacific Ocean at Callao (Lima); the total area of the watershed is 3,504 km^2. Its water is used for large, medium, and small-scale farmers who rely on this watershed for crop irrigation, domestic needs, industry, mining, aquaculture (fish farming) and production of hydroelectricity. Together with the Chillón and Lurín rivers, the Rímac supplies water to about 9 million people in Metropolitan Lima. Social conflicts about water increase during drought years, when there is more demand for irrigation and supply is insufficient.

In the past few decades, Lima has received high migration from rural areas and unplanned processes of urbanization. Because of lax land planning and enforcement, about 30,000 people (mostly, low-income) have settled in hazardous spaces, such as the margins of the Rímac River. (Figure 12). These settlements ("asentamientos humanos") obstruct natural flows, reduce streamflow and hinder evacuation of high flows, leading to rapid increase in disaster risk. In addition to the hazardous location of settlements, the materials and construction processes used in many homes contribute to their vulnerability to climatic hazards. These dwellings are exposed to floods, overflows, landslides and debris flows caused by flash floods (known locally as "huaycos") in steep, unstable terrain. To reduce the impacts of these extreme events in the basin, it is necessary to strengthen the local risk management and disaster prevention capacities, in part through enhanced weather/climate information as well as better coordination supported by scientific evidence for the integrative management of the territory [29].

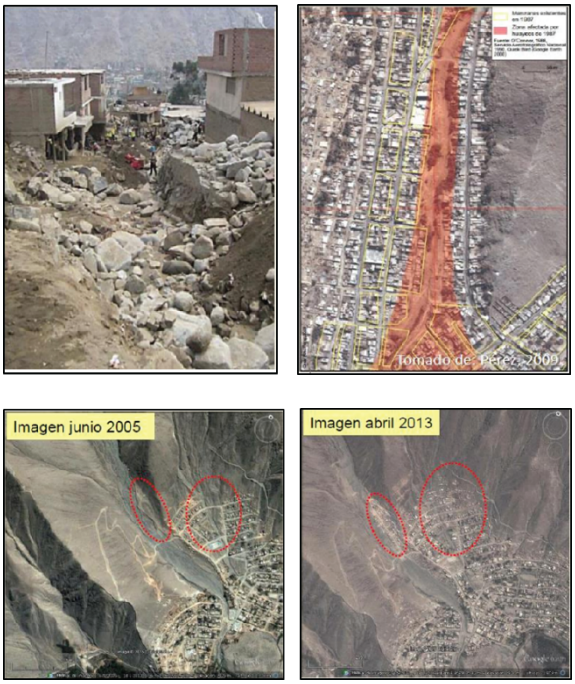
Figure 11. The Rímac River Basin, flanked by the Chillón Watershed to the North and the Lurín Watershed to the South. Source: Aquafondo, 2011, *Fondo del agua para Lima y Callao. Líneas estratégicas y proyectos en cartera.*



Average precipitation on the Rímac Basin increases with altitude. Nevertheless, extreme precipitation events are not necessarily tied to altitude: floods or huaycos can occur in places where mean annual rainfall is extremely low. Natural

runoff is modulated by seasonal rainfall in the upper basin and the extent of snow in that area. Maximum flows occur in January-March and small flows take place during April-December. The total annual demand for water from the Rímac watershed is 635 Mm^3 [143], with domestic use by far providing the highest demand. During the dry season (May-November), the highland lakes and dams that regulate the Rímac flow do not provide enough water to satisfy the demand of metropolitan Lima.

Figure 12. Low-income settlements (top left) along the margins of the Rímac River (top right). Satellite images (bottom row) show differences in the area occupied by dwellings between June 2005 (left) and April 2013 (right).



3.3.3.2 The Huallaga Basin

The second adaptation demonstration site in Peru is the Huallaga River Basin (HRB) in northeastern Peru. The focus in this site will be on the development of most of the elements required for an early warning system for floods. Floods appear to be occurring more frequently and intensely in the last two decades; their risks are exacerbated by the haphazard occupation of river margins by the population.

The Huallaga River Basin is located in the Peruvian Amazon–Andes basin (PAB) where two distinct natural regions can be distinguished: the Amazonian floodplain and the Andes (Figure 13). The first region consists of relatively flat lowland plains, whereas the second region encompasses the Andes mountains [144]. The Huallaga River originates at 4710 m.a.s.l. and has a length of 1389 km. The basin covers an area of 95,000 km^2. The Huallaga feeds into the Marañón, which in turn feeds the Amazon. The basin includes three national parks (Río Abiseo, Cordillera Azul and Tingo María), several national forests and privately owned conservation areas.

Climate variability in the Huallaga is considerable due to the size of the basin and the contrasts between the Amazon plain in the lower parts and the Andean region in the highlands. Average annual precipitation over the basin is about 1738 mm. High precipitation is observed in Tingo María (> 3000 mm yr^{-1}) and in the Lower Huallaga (> 2000 mm yr^{-1}); lowest rainfall occurs in the Sierra in Huánuco (< 500 mm yr^{-1}). Annual average temperature is about 17.6°C.

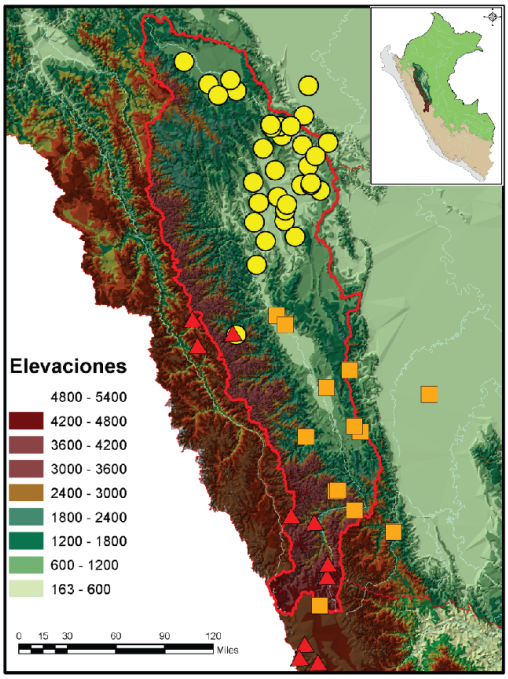
The main climatic hazards in the Huallaga basin have been droughts and floods, with the latter having been reported more frequently and intensely in the last two decades [145]. The flood risks are compounded by settlements located mostly along river margins. Large floods have occurred in November 2006 in the department of San Martín, isolating several populated areas. This event caused losses and damages to 2251 people, and almost 14,000 were affected. In January-March 2007, high precipitation caused floods and huaycos in the central Sierra (Huánuco, Pasco and Huancavelica) and the Selva (Junín). Eighteen people lost their lives because of these events, hundreds were hurt, and hundreds of homes were destroyed. Other flooding occurred in 2009. The hydrological year from September 2012 to August 2013 was extremely rainy, with about 1825 mm accumulated. The climate of the Peruvian Amazon Basin has been projected to undergo major changes that will have dramatic consequences on the region's hydrology and will create significant policy issues; recent studies show some evidence for the expected changes [144].

Despite the risks of floods, water is critical for this region due to its agricultural potential (≈20% of the basin is dedicated to agriculture) and grazing (15% involves grasslands). The main products in the region are

sugarcane, bananas, citrus fruits and the raising of pigs and poultry. Agriculture occurs in well-defined areas, for which groups of water users for irrigation have been formed. Annual water consumption for irrigation has been estimated at over 493 hm^3; there are plans to extend the irrigated area. The basin also stands out for providing jobs for native communities through timber production, trout farming, and tourism. In addition, the basin has important ecosystems that are vulnerable to extreme climate events such as páramos and humid and dry forests [146, 147].

Hydroelectric production in the Huallaga is limited and it involves five working plants, but there are plans to considerably expand hydropower generation through the construction of additional plants; the high and intermediate basins have the largest potential for generation, but this needs to be assessed further [145].

Figure 13. The Huallaga Basin in northeastern Peru. Background colors indicate elevation. Symbols denote hydrometeorological stations. Yellow circles are stations with a bimodal rainfall distribution, whereas orange squares and red triangles indicate a unimodal rainfall regime.



The population of the Huallaga Basin is over 1,700,000 people, who mostly inhabit the departments of San Martín (49%) and Huánuco (34%). The rest of the population is distributed among the departments of Pasco, Loreto, Amazonas and la Libertad [145]. About 55% of the population of the Huallaga Basin is poor, with ≈27% under extreme poverty. Average illiteracy in the Huallaga Basin is about 12.7%, although it is more than twice as frequent among women (18.7%) than for men (6.9%). Only about 45% of the population has some kind of health insurance [145]. The ethnic composition of the Huallaga Basin population is diverse. Indigenous populations include the Aguarunas or Awajun in the Alto Mayo, an affluent of the Huallaga. The Andean population is organized into farming communities and they cultivate potatoes and maize, and raise camelids.

4 Project Components and Financing

Table 5. Relationships among project outcomes and related outputs, and their corresponding budget. All budget numbers are expressed in US dollars.

Expected Outcomes and Related Outputs	Countries involved	Amount (USD)
Outcome 1: Enhanced design, production and communication of climate/water information and services.		
Output 1.1. National climatic and hydrological data management systems have been enhanced and updated. WIGOS implementation supported.	CL, CO, PE	581,257
Output 1.2. The characterization and communication of historical and recent states of climatic hazards have been improved.	CL, CO, PE	299,479
Output 1.3. The production and dissemination of forecasts of high-impact weather has been improved.	CL, CO, PE	427,625
Output 1.4. The production and dissemination of sub-seasonal to seasonal (S2S) predictions of regional climate and hydrological conditions has been improved.	CL, CO, PE	304,222

Output 1.5: The access, processing and dissemination of multi-model projections of regional climate change (decadal to multi-decadal) from multiple institutions and models has been made easier.	CL, CO, PE	137,500
Output 1.6: Procedures and tools have been implemented by NMHSs to downscale seasonal forecasts and climate change projections in space/time. Global forecasts/projections have been calibrated for the ENANDES region.	CL, CO, PE	128,982
Outcome 2: Strengthened institutional coordination and value-adding tools and processes allow climate/weather information to be tailored and translated into user-centric and sector-specific adaptation actions.		
Output 2.1: (a) Knowledge and action networks have been implemented that facilitate the design, production, delivery, and use of climate information and services; relevant strategic partners have been engaged; and (b) capability gaps in strategic partners have been identified and addressed.	CL, CO, PE	180,142
Output 2.2: The needs for tailored weather/climate information have been identified for target sectors in demonstration adaptation regions.	CL, CO, PE	166,443
Output 2.3: Sectoral models have been used to "translate" observed/predicted weather/climate conditions into likely local impacts at demonstration sites.	CL, CO, PE	170,832
Output 2.4: Communication and knowledge management strategies have been developed for ENANDES. Relevant information about observed/predicted weather/climate hazards and their likely impacts are routinely communicated through appropriate channels.	CL, CO, PE	341,563
Output 2.5: Multiple requisites of a National Framework for Climate Services, such as identification of stakeholders and information needs and implementation of national dialogs, have been addressed.	CL, CO, PE	312,380
Outcome 3: Engaged and empowered stakeholders have participated in the co-development and implementation of local plans and activities for adaptation to climate variability and change that rely on climate/water information.		
Output 3.1: The factors that determine vulnerability to climatic variability and change have been identified for the sectors and regions targeted.	CL, CO, PE	242,801
Output 3.2: Capacity building and outreach efforts have improved the accessibility, comprehension and use of climate and water information for risk management and adaptation among local stakeholders and communities.	CL, CO, PE	240,296
Output 3.3: Context-appropriate preparedness and adaptation plans and actions to reduce local damages from climate variability and change have been designed through participatory processes. Demonstration projects have been implemented and monitored to test those plans and actions.	CL, CO, PE	273,997
Output 3.4: Early-warning systems and enhanced processes for inter-institutional coordination have (i) strengthened national/local management of risks and (ii) have reduced the negative impacts of droughts and floods for demonstration adaptation sites/sectors.	CL, CO, PE	777,332
Output 3.5: Evaluations of the socio-economic benefits of ENANDES demonstration adaptation actions have been carried out.	CL, CO, PE	293,749
Output 3.6: Useful lessons on local adaptation actions have been provided by an active project tracking effort (complementary to M&E	CL, CO, PE	246,500

efforts) that allowed active adaptation of goals, outcomes and outputs throughout the project.		
Expected Outcome 4: Regional and global coordination and cooperation mechanisms are strengthened; lessons, tools and approaches from ENANDES help others to provide climate services and replicate adaptation actions elsewhere.		
Output 4.1: Regional coordination activities have been carried out to support the update of national climatic and hydrological data management systems, and interoperable regional databases.	CIIFEN/RCC-WSA, CL, CO, PE	60,000
Output 4.2: Complementary support provided to strengthen national capacities for climate monitoring and prediction.	CIIFEN/RCC-WSA, CL, CO, PE	190,000
Output 4.3: Complementary support provided to strengthen capacities for climate services production, dissemination and uptake.	CIIFEN/RCC-WSA, CL, CO, PE	165,000
Output 4.4: Regional Technical Working Groups have been re-convened, revitalized or established. Active liaison with other ongoing projects in the region has achieved positive synergies and enhanced economic efficiency.	CIIFEN/RCC-WSA, CL, CO, PE	305,000
Output 4.5: A Climate Services Toolkit (CST) has been implemented that is tailored to the previously determined operational needs of ENANDES NMHSs.	CIIFEN/RCC-WSA, CL, CO, PE	175,000
Output 4.6: Capacity building efforts for ENANDES have been defined by ENANDES participants, and jointly implemented by WMO Regional Training Centers, WMO Training Activities Division and other institutions.	CIIFEN/RCC-WSA, CL, CO, PE	180,000
Cost of Project Activities (A)		6,200,000
Project Execution Cost (B; 9.5% of A+B)		650,000
Total Project Implementation Cost (A + B)		6,850,000
Implementing Entity Fee (8.5% of Project Implementation Cost)		582,250
TOTAL Amount of Financing Requested		**7,432,250**

4.1 Projected Calendar

Table 6. Expected dates of specific milestones for the proposed project.

Milestones	Expected dates
Start of Project Implementation	1 November 2019
Mid-term Review	November-December 2021
Project End	31 October 2023 (48 months)
Terminal Evaluation	September-November 2023

PART II: PROJECT JUSTIFICATION AND DESCRIPTION

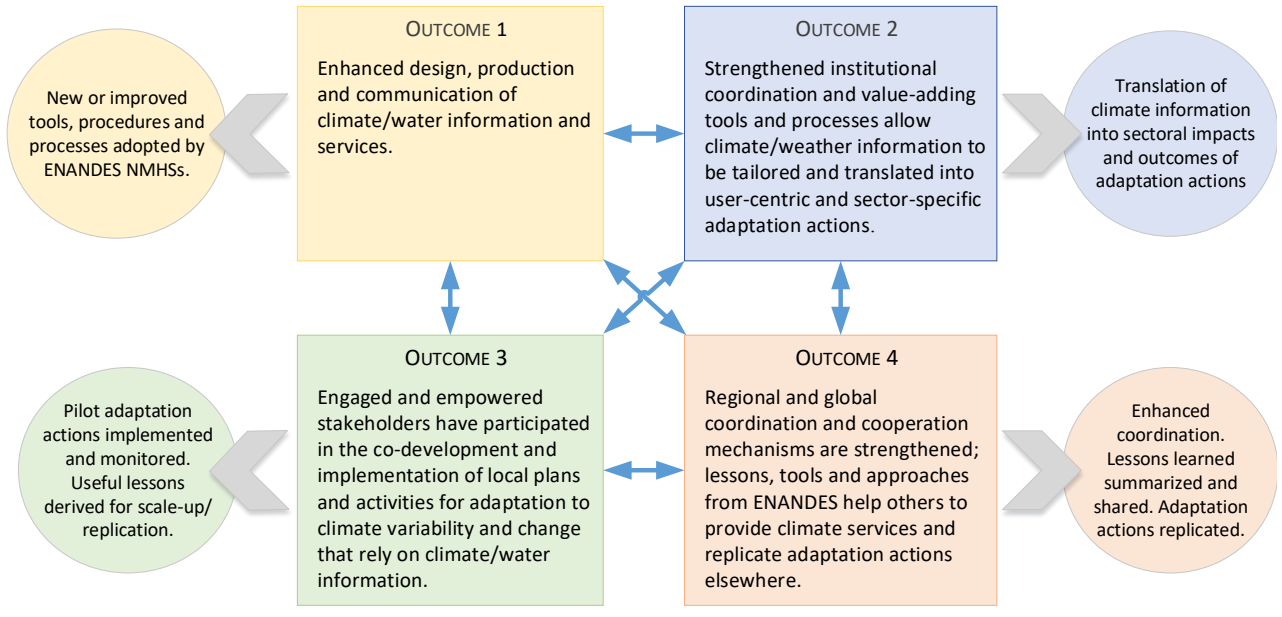
5 Project Description (A)

5.1 Project Overview

The ENANDES Project is organized into four closely intertwined outcomes (Figure 14). These components and their main expected outputs are described in detail in sections below. The ENANDES outcomes include:

- *Outcome 1* will strengthen the capacity of NMHSs in Chile, Colombia and Peru to provide useful climate services, i.e., to produce and communicate actionable, sector-tailored climate and water information and knowledge (Figure 1, bottom), focusing particularly on the information needed by the proposed demonstration adaptation activities;
- *Outcome 2* will develop necessary tools to add value to, and translate climate information into actionable knowledge – thus adding the components needed to complete the climate value chain – and will strengthen linkages and collaboration across a broad network of international, national and local institutions from agriculture, water, and energy to allow successful implementation of demonstration adaptation activities (Figure 1, top);
- *Outcome 3* will implement and monitor demonstration adaptation activities across the three ENANDES countries to gain practical experience on the use of enhanced climate services and networks of relevant actors (resulting from Outcomes 1 and 2) to support decisions and policies; and
- *Outcome 4* will provide enhanced coordination and planning among countries of western South America and ongoing climate-related efforts to maximize positive synergies and increase economic efficiency of investments in the region; it will coordinate capacity building efforts within ENANDES countries and the needs of the region at large; it will also summarize and communicate lessons learned to support subsequent replication and scale-up in other contexts.

Figure 14. Schematic description of the four ENANDES intertwined outcomes (boxes). Text in the circles indicate the main output(s) of each component.



5.2 Project Outcomes and Related Outputs

5.2.1 Outcome 1. Enhanced design, production and communication of climate/water information and services.

This outcome seeks to improve how information and knowledge about extreme weather events, and climate variability and change is produced and communicated by ENANDES NMHSs. The specific outputs associated with this component are described in the following paragraphs.

Output 1.1. National climatic and hydrological data management systems have been enhanced and updated through improved/new tools and processes. WIGOS implementation has been supported.

Long-term, continuous, quality-controlled observations are critical for defining the evolving state of the Earth's climate [148]. In turn, reliable Climate Data Management Systems (CDMSs) are the basis for generating good climate services. The WMO has produced recommendations on the various components that a CDMS should include, and those guidelines will inform this activity [149]. A CDMS should include well-structured data stored in high-performance databases designed with data models adequate to fulfil multiple user requirements [150].

This output will require a critical assessment of the status of meteorological and hydrological observational networks and data repositories in each country – including identification of possible improvements. The survey will include earlier initiatives led by CIIFEN prior to its designation as RCC (e.g., HYDEX and SOPHI data exchange tools). The assessment of observational networks will follow a gap analysis approach, comparing existing observational capabilities against the standard WMO requirements such as those of the Global Basic Observing Network (GBON). Additionally, critical support activities like instrument calibration and maintenance will be assessed.

If countries adopt a common CDMS model – despite the unavoidable trauma of transitioning to a new system – maintenance, development of tools and interoperability would be facilitated; such a move will be seriously explored after project inception. Moreover, ENANDES will place particular attention on hydrological data, as they tend to be less structured and integrated than climate records. The Project will explore use of WaterML2, a hydrological data exchange standard adopted by WMO and several national and international organizations (www.waterml2.org). WaterML2 helps to exchange many kinds of hydro-meteorological observations without changes in original databases or legacy software.

ENANDES will undertake the preservation and digitization of climate and water data at risk of being lost due to deterioration of the medium in which they are stored (e.g., records still on paper). The project will digitize past data into computer compatible form for easy access. Priority will be given to data from demonstration adaptation sites (Section 3.3). ENANDES will build on SENAMHI's experience in data rescue during project Climandes and other successful experiences. Data rescue activities will be coordinated with the international Atmospheric Circulation Reconstructions over the Earth (ACRE, www.met-acre.net) and the WMO-sponsored International Data Rescue (I-DARE, www.idare-portal.org) initiatives, both of which facilitate the recovery and digitization of weather observations.

Better management of climate/water metadata ("data about the data") is a common need among ENANDES countries. Good metadata can significantly improve the quality of scientific analyses, particularly the study of climate variability: for example, helping to identify artificial trends tied to changes in station location or instrument replacement. The project will enhance regional metadata management approaches so they are available in the WMO Observing Systems Capability Analysis and Review Tool for surface observations (OSCAR/Surface), a metadata resource to support Earth Observation studies and global coordination. Technical WIGOS workshops will be organized for ENANDES national focal points, involving experts from the Regional WIGOS Center.

Good-quality observations are central to the production of climate services. This output will build on earlier efforts to perform quality control (QC) of historical observations (e.g., the AndesQC system commissioned by CIIFEN and developed by Dr. E. Aguilar). A need unanimously identified by ENANDES countries is the QC of data collected by automated weather or hydrological stations that produce large data volumes (e.g., measurements every 5-10 minutes). QC procedures will be developed collaboratively by all ENANDES NMHSs using free, open source software (e.g., the R statistical language) and common coding protocols, so that the procedures can be easily shared across the region and elsewhere. In addition to QC, ENANDES will implement state-of-the-art homogenization procedures to correct for shifts or discontinuities in time series.

Output 1.2. The characterization and communication of historical and recent states of climatic hazards have been improved through new/enhanced tools and processes.

This output will involve two major groups of activities. The first group will focus on a thorough characterization of the *historical* behavior of the climate of a country through statistics and descriptions that typically include analyses of central tendencies and higher order statistics over months, seasons, years and decades. Descriptions will be based on relevant climate and water variables, context- and sector-specific indices and climate extremes. In order to fix any statistical issues within a historical data set, new approaches to calculate climate "normals" will be implemented [151, 152]. This work also will seek to identify main modes of variability, their linkages with global patterns (e.g., ENSO), and the interactions or modulation among variability modes. Once associations are understood, they will help refine regional outlooks.

Changes in extreme weather and climate events are among the most serious challenges to society. Knowledge of extremes, therefore, is essential to manage climatic hazards to humans, ecosystems and infrastructure, and to develop adaptation strategies. The WMO has provided scientific and technical guidance on extremes – including several indices defined by WMO's Commission for Climatology (CCI) Expert Team on Climate Change Detection and Indices (ETCCDI) that will help strengthen the capacities of ENANDES countries to answer questions such as whether extremes in the region have changed and to communicate such knowledge to the users [153].

The second part of this output involves the routine monitoring and timely communication of climate conditions in the recent past (weeks to months before present) to support decisions. A set of relevant sector- and impact-specific variables or indexes will be defined to characterize the current state of climatic hazards (i.e., provide diagnostics) and inform decisions in the target sectors and communities. Candidate variables and indicators include context-specific quantities associated with specific socio- economically relevant/sector outcomes. For instance, they may include climate variables relevant for climate-sensitive sectors, sector-specific indices (drought indices), or quantities associated with high-impact events such as heatwaves, floods, droughts, storms, frosts and freezes, etc. ENANDES monitoring activities will build solid foundations for national *climate watch systems* providing advisories and statements about evolving or foreseen climate anomalies at the regional and national levels to inform users, particularly those involved in natural hazards preparedness, mitigation and response.

Output 1.3. The production and dissemination of forecasts of high-impact weather has been improved through new models and processes.

This output reflects the need to enhance capabilities to generate weather predictions, particularly near-real time predictions of high-impact weather events such as freezes or high-intensity precipitation events leading to flash floods. For instance, intense precipitation is very relevant to the Rímac Basin in Peru (Section 3.3.3.1) where intense rainfall on steep, arid slopes may trigger debris flows or huaycos. Elsewhere in South America, flash floods account for a significant portion of the lives lost and property damages that result from flooding. Given that flash floods can occur at any time or place with disastrous results, there is an urgent need to prioritize efforts that seek to improve early warning capabilities.

ENANDES aims to contribute to the reduction of vulnerability to hydrometeorological hazards, including flash floods and associated landslides. Ultimately, the three countries would like to strengthen their capacity to develop timely and accurate flash flood warnings: this is one specific area where collaboration with external partners would shorten implementation times and reduce project costs. For these reasons, ENANDES will explore collaboration with the Flash Flood Guidance System (FFGS) project being developed by the WMO Commission for Hydrology in collaboration with the US National Weather Service, the US Hydrologic Research Center (HRC) and with support from USAID/OFDA. The different contexts in which flood warnings are needed may require different approaches from the FFGS toolkit.

In addition to possibly pursuing collaboration with the FFGS, ENANDES may liaise with other ongoing efforts targeting severe storms. For example, the RELAMPAGO Project is taking place in central Argentina – an area that shows some of the most intense convective systems in the world with respect to the frequency of large hail, high storm tops, and extreme lightning activity. RELAMPAGO seeks to understand questions related to the stages of severe storm development, which are poorly understood. Although Chile is the only ENANDES country with some participation in RELAMPAGO – via the Univ. of Valparaíso – efforts should be made to increase linkages between the two projects for the sake of reducing startup times, avoiding duplication of efforts and achieving synergies and economic efficiency.

Output 1.4. The production and dissemination of sub-seasonal to seasonal (S2S) predictions of regional climate and hydrological conditions has been improved through new models and processes.

ENANDES will strengthen and expand the regional capabilities to produce forecasts of regional climate conditions on sub-seasonal to seasonal (or "S2S") scales. Seasonal forecasting is the prediction of the climate of coming seasons and how the expected regional conditions may differ from previous years or long-term climatology [16, 107, 108]. Institutions in the region already produce usable and useful operational seasonal predictions, mainly through statistical procedures [29]. In contrast, the region has limited experience and capacity on the topic of sub-seasonal prediction, i.e., timescales from two weeks to a season [36].

Active research is seeking to fill the temporal gap between weather predictions (up to 10-14 days ahead) and seasonal forecasts through sub-seasonal prediction [36]. WMO launched the Sub-seasonal to Seasonal Prediction Project (S2S) in 2013, with the primary goals of improving forecast skill and understanding on the sub-seasonal to seasonal timescale. The sub-seasonal forecasts have promise for decision-making in the ENANDES region, but regional capabilities need to be strengthened. To this effect, ENANDES will pursue active collaboration among the three countries and with institutions elsewhere with expertise on this topic.

For example, ENANDES might collaborate with the International Research Institute for Climate and Society (IRI), an institution that is developing a system a "seamless" system that combines sub-seasonal and seasonal forecasts called "NextGen," for the Next Generation of Climate Forecasts. Colombia's IDEAM already has been collaborating with the IRI and Guatemalan institutions on NextGen forecasts. Moreover, Chile has asked the State Meteorological Agency of Spain and WMO for funding to implement NextGen this year. Consequently, this is a topic where active collaboration not only among ENANDES countries but also with key external partners may speed up significantly the regional implementation.

The NextGen is a completely general approach that (a) takes full advantage of local expertise to configure the S2S prediction system, (b) selects best numerical climate models (e.g., those in the North American Multi-Model Ensemble and the Copernicus Climate Change Service based on faithful reproduction of physical patterns and actual skill for a country, and (c) statistically calibrates each model via CPT [154], a well-known tool for most NMHSs, before producing a multi-model ensemble in probability space. That is, NextGen will yield the entire distribution of predicted values for a climate variable, rather than just one mean expected value; this may be useful for risk management purposes.

Although seasonal forecasts have focused mostly on predicting total rainfall amounts, NextGen seeks to expand the scope of variables to be predicted, including the frequency of rainy/dry days, and minimum, maximum and average temperatures. Temperature forecasts, which are often found to be more skillful than those for rainfall, may have great benefit for areas prone to flash floods as a result of snowmelts. Temperature forecasts also could provide information on heat waves and their likely duration.

Output 1.5: The access, processing and dissemination of multi-model projections of regional climate change (decadal to multi-decadal) from multiple institutions and models has been made easier by the development of new tools.

Because of the highly-specialized expertise and the significant computational capabilities that are needed, the regional generation of climate change scenarios is probably beyond the scope of ENANDES. Instead, a better approach will be for the project to enhance regional capabilities to access, analyze and visualize climate projections produced by global or international centers as part of programs such as the Coupled Model Intercomparison Project (CMIP), whose output is to be used in upcoming Intergovernmental Panel on Climate Change (IPCC) reports, or the CORDEX project [155]. The CORDEX Science Advisory Team will be approached to help guide this component.

An example of a useful repository for climate change projections is the Earth System Grid Federation (ESGF, esgf.llnl.gov) – an international collaboration that manages the first-ever decentralized database for handling climate science data, with multiple petabytes of data at dozens of federated sites worldwide. It is recognized as the leading infrastructure for the management and access of large distributed data volumes for climate change research.

Specifically, ENANDES will aim to facilitate access to global climate projections through an effort to be coordinated by CIIFEN/RCC-WSA. CIIFEN/RCC-WSA will develop a "one-stop" location to get output from multiple models, and will provide basic tools (e.g., cropping data for specific regions of interest) to facilitate further use or analysis by NMHSs. Additionally, ENANDES will explore the feasibility of developing and implementing procedures and tools for region- or country-specific post-processing of seasonal forecasts and climate change projections from dynamical models (e.g., calibration, debiasing).

Output 1.6: Procedures and tools have been implemented by NMHSs to downscale seasonal forecasts and climate change projections in space/time. Global forecasts/projections have been calibrated for the ENANDES region.

This output will involve the implementation, testing and documentation of procedures to evaluate the performance (skill) of S2S climate forecasts (statistical or dynamical) including standardized verification metrics, as well as approaches for downscaling seasonal forecasts and climate projections in space and time, for example, to drive process models that require fine-grained input.

5.2.2 Outcome 2: Strengthened institutional coordination and value-adding tools and processes allow climate/weather information to be tailored and translated into user-centric and sector-specific adaptation actions.

This component of ENANDES focuses on strengthening the "other" ingredients or components of the value chain (Figure 1, bottom) necessary to provide effective climate services, beyond the mere production of climate information and knowledge. It is clear that users of climate services will not be served by information provided only in terms of observed climate data or model projections. There is an expectation that climate services will advise the users on how to use the information, how to deal with uncertainties, and how to respond to the specific challenges users are facing [69]. This component, consequently, seeks to understand and implement appropriate processes for sustained two-way interactions with stakeholders, assess user needs and expectations for sector-specific climate information to support adaptation actions, and identify effective mechanisms and formats for the operational delivery of climate services.

Output 2.1: Knowledge and action networks have been implemented that facilitate the design, production, delivery, and use of climate information and services; relevant strategic partners have been engaged; and capability gaps in those partners have been identified and addressed.

Effective adaptation actions require strong inter-institutional networking and cooperation with clearly defined roles and responsibilities, and firm policy commitments. The importance of user engagement is widely acknowledged in building trust, but rather than a need for more engagement in itself*, there is a strong need for more targeted and efficient forms of stakeholder engagement.* A key activity will be to map the landscape of relevant institutional and social actors from climate-sensitive sectors in demonstration adaptation regions and nationally, including those institutions that can contribute to understanding vulnerability to climate hazards. This stakeholders' map will not be merely an exhaustive list of institutions. Instead, the map will aim to clarify the roles and responsibilities of potential ENANDES actors. Special attention will be placed on gender, age, income and ethnicity dimensions for potential partners. Once identified and characterized, the active engagement in ENANDES activities of key network members will be secured through formal institutional agreements or other arrangements. A systematic stakeholder and network analysis should help set the project's priorities for engagement and outreach efforts.

Traditionally, the end-to-end system linking climate services providers to users is referred to as the value chain (e.g., see Figure 1). Nevertheless, the interdependent nature of linkages among targeted sectors such as "energy for water", water for energy", "water for food", etc. [156], suggests that the collaboration and information flows of regional climate services should be conceptualized instead as a broad knowledge network with multiple overlapping sub-networks of institutions or actors targeting different constituencies or sectors [157]. ENANDES will highlight the critical role in this network of intermediary or "boundary" organizations that help connect providers and users effectively and can amplify the impact of project's activities [158, 159]. They provide a useful alternative to the linear "pipeline" model of transfer of scientific information, facilitating instead a multi-directional flow of information between science and decision-makers [25, 51]. Different boundary organizations will participate in the various adaptation areas. For instance, the Mesas Técnicas Agroclimáticas [160] will be implemented as an adaptation action in all three countries (details below). Implementation will be performed in partnership with each country's Ministry of Agriculture – i.e., these ministries become the boundary organizations. In other cases, for example in the Popayán municipality of Colombia, ENANDES will work with two well-established NGOs: the Río Piedras and Ecohabitats Foundations. Other initiatives such as Peru's "Dialoguemos NDC" effort initiated by the Ministerio del Ambiente, also seek to articulate dialog among multiple governmental jurisdictions, sectors and actors – including the private sector – about adaptation to climate change.

Output 2.2: The needs for tailored weather/climate information have been identified for target sectors in demonstration adaptation regions.

At the root of most barriers to the use of climate information lies a fundamental misfit between the scientific capabilities of information producers and the expectations, needs and beliefs of potential users. Activities in this output will help to understand, the needs for information of climate service recipients, their communication and information-seeking preferences, how they incorporate climate-related information into decisions [161]. Through various formats including focus groups, open-ended interviews, surveys, and field schools, ENANDES will investigate what stakeholders perceive about climate patterns and trends. This assessment is crucial, because relatively unfamiliar information – e.g., seasonal forecasts or climate change projections – is interpreted by users in the context of existing beliefs [128-130]. Consequently, inaccurate perceptions may lead to inappropriate responses or maladaptation [132]. Following the "mental models" approach of Morgan et al. [131], ENANDES will seek to "learn what people know and believe." ENANDES recognizes the existence of multiple visions and perspectives about climate – from the mainly technical perspectives from climate and sectoral experts and institutions, to the peasants' first-hand experiences of climate impacts, to the ancestral traditions about climate of indigenous communities. In addition, the

literature identifies differing climate information needs linked to gender [162-164]. Ultimately, ENANDES will seek to reconcile any tensions emerging from these different perspectives and needs.

Through interactions with stakeholders, ENANDES will identify what is required in order to make climate information usable, and how this varies between users in different sectors, different organizations within a sector and organizations with different levels of weather and climate data experience. For instance, would certain users prefer raw diagnostic or forecast information? Do they have capacity to do their own analysis of the information? Do they require a product/tool to translate the forecast information into something usable? How would they want to engage with the information? How should uncertainty, skill and reliability be described/integrated [165]? The fit between information and needs will develop through sustained interaction between producers and users of information: users can learn to expand their choice set in response to new information, while producers adapt their products to the evolving capacity of users [58]. The effectiveness of this dialog will be monitored and assessed as part of the project's work [166].

The NMHSs of ENANDES countries also will work with decision-makers to define protocols for the visualization of diagnostic and forecast climate information. Alternative product formats [135] and ways of conveying uncertainty [136] will be evaluated with stakeholders. Seasonal forecasts will be tailored to be more directly related to the variables of interest to regional users. As discussed in Output 1.4, tailoring will involve prototyping of products that extend the widespread tercile probability format to generalized probability distributions that are more amenable to problem-specific applications and can be easily used as input to sectoral process models; for examples of viable approaches see [137] and [138]. Tailored forecasting should be used as a platform for integrated fundamental and applied research [165].

Output 2.3: Sectoral models have been used to "translate" observed/predicted weather/climate conditions into likely local impacts at demonstration sites.

To support public and private adaptation and mitigation responses, information must be credible, legitimate and, especially, salient – i.e., relevant to the needs and decision protocols of specific decision makers [25]. Needs include not only predictions or projections[1] [167] of regional climate: *potential outcomes of adaptation actions are probably more relevant to stakeholders than raw climate information.* For example, farmers prefer to hear what might happen on their farm, such as likely distributions of crop yields or economic returns, rather blanket statements like a forecast for a rainy summer [160]. *An enhanced capacity is needed to "translate" climate information into likely distributions of outcomes for risk assessment and management [168, 169]. Without such translation, decision makers cannot evaluate whether particular adaptation actions might achieve their goals.*

As part of this output, ENANDES will rely on the best available physical, biological and social science to translate climate information into quantitative assessments of (i) the likelihood of regional climate impacts (including extreme events), (ii) their associated consequences on water, energy and agriculture, and (iii) the outcomes of feasible alternative adaptation actions.

ENANDES will use sectoral models (mechanistic or statistical) to "translate" climate information into distributions of outcomes for risk assessment and management [168]. For example, Colombia and Chile will use crop biophysical models [170] to simulate the results of individual adaptation or mitigation actions, e.g., crop yields or economic profits. Coupled with climate and weather forecasts, crop models have improved to the point that a realistic prediction of crop performance under a range of climate conditions and management is possible [41, 168, 171-173]. Many crop models simulate realistic outcomes of management practices (e.g., genotype used, planting date, fertilization amount), so they allow exploration of a large portion of the

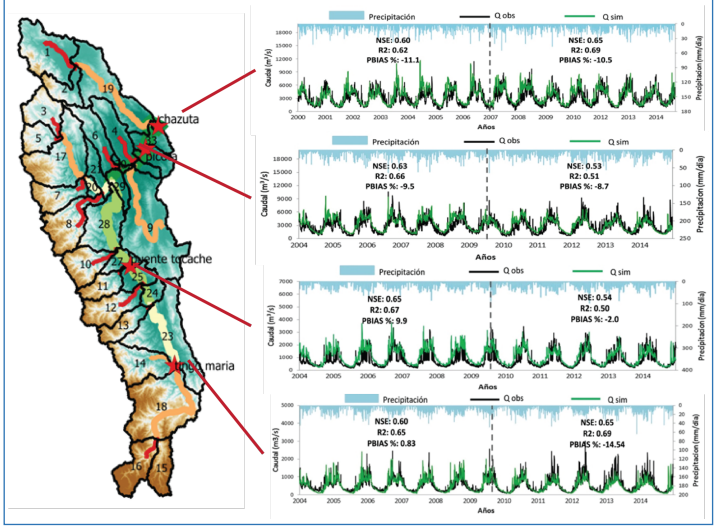
[1] Following Bray and von Storch (2009), ***prediction*** conveys a sense of certainty whereas ***projection*** is associated more with the possibility of something happening given a certain set of plausible, but not necessarily probable, circumstances. A prediction can be used to design specific response strategies, while a projection, or more precisely a series of projections, provides a range on which to consider a range of response strategies.

potential decision space to assess the scope for climate-adaptive management of cropping systems. A systematic approach is required so that farmers not only have access to information on probable climate patterns and crop responses, but also with growers participating in the discussion of how to best use the results of the climate prognosis and the crop production predictions [160, 173].

There are multiple crop models that can be used (e.g., CROPWAT, AQUACROP and DSSAT) [174]. The choice of specific model will relate to the crops targeted – sometimes models are not available for the crops cultivated by smallholders – and the availability of input data, as input requirements vary among models. ENANDES partners (e.g., Colombia's IDEAM) already have some experience in crop modelling, for example, with AQUACROP). For those instances when no crop models or necessary information existed, the explicit and tacit knowledge of ENANDES partners and local stakeholders will be used. In Colombia, the approach of using climate and agronomy models, validated for local contexts, coupled with strengthened local capacity to understand climate and its impact on agricultural processes has been shown to help farmers manage climatic risk [160].

To deal with early warning systems of floods, some ENANDES countries envision use of the Soil and Water Assessment Tool (SWAT). SWAT is a physically based, deterministic watershed-scale simulation model developed by the US Dept. of Agriculture's Agricultural Research Service [175]. SWAT has evolved from numerous individual models over a 30-year period and has been tested for a wide range of regions, conditions, practices, and time scales. The model includes weather, surface runoff, return flow, percolation, evapotranspiration, transmission losses, pond and reservoir storage, crop growth and irrigation, groundwater flow, reach routing, nutrient and pesticide loading, and water transfer. An example of simulated streamflow in four locations of the Huallaga Basin (one of the demonstration sites in Peru) is shown in Figure 15. All locations show r^2 coefficients ranging from 0.62 to 0.67. Simulations like these will be used to generate flood likelihood for expected climate conditions. Similarly, Colombia is exploring development of rainfall-runoff models based on data from new hydrological stations to be operated by volunteers.

Figure 15. Calibration and validation series of daily streamflow in four locations of the Huallaga River Basin modelled using SWAT. The four time series correspond, from top to bottom, to Chazuta, Picota, Puente Tocache and Tingo María. Source: SENAMHI, Peru.



Output 2.4: Communication and knowledge management strategies have been developed for ENANDES. Relevant information about observed/predicted weather/climate hazards and their likely impacts are routinely communicated through appropriate channels.

A central objective of the ENANDES communication and knowledge management strategy is to raise awareness and understanding of climate risks and adaptation solutions, with a culturally- and gender-sensitive lens. Increasing awareness through outreach and engagement will require well-planned actions that consider today's complex and changing information environment. Using new communications approaches to knowledge sharing that quickly reach wide audiences countries can speed the adoption of adaptation successes through modern communication capabilities [81]. These capabilities present both unprecedented opportunities and a new array of challenges. It is indeed faster to communicate now, but the speed of communication can also make it easier to lose trust and credibility through communication missteps [161], hence the need for a well-thought knowledge management strategy.

An important design consideration for ENANDES is to avoid an "information producer – information user" approach in which information producers place climate diagnostics and forecasts "on the loading dock" [48] for users to pick up and use. Instead, the project will foster an iterative interaction between information producers and users, an approach that is the most critical factor affecting uptake of climate information [176].

Enhancing trust in climate services is another fundamental challenge being faced by providers. Complicating this challenge is how best to communicate uncertainty to different sectors that handle information in different ways depending on their decision-making frameworks. The assessment and communication of uncertainty is critical in developing confidence in climate services. An important aspect to be considered as part of ENANDES activities is the need for methods and appropriate metrics that test the efficacy of communication strategies to ensure that appropriate and accurate uncertainty information is provided and that this is interpreted correctly [177].

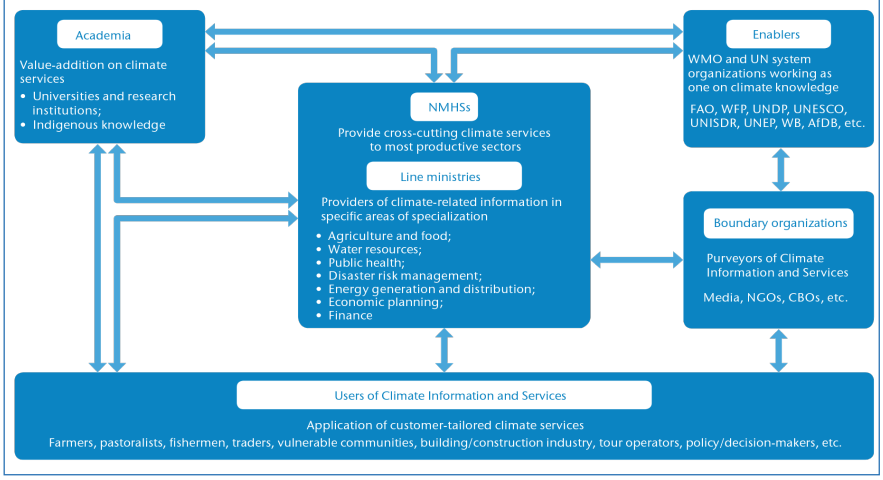
ENANDES will develop and implement a project communications and knowledge management strategy. An expert in scientific journalism or communication will be recruited to help develop a consistent strategy to give appropriate diffusion to ENANDES activities, including an active presence in social networks, and establish working relationships with governmental agencies and international donors who may contribute to the future sustainability of ENANDES. Outreach activities in appropriate for a (schools, science museums, radio and TV programs) will also be developed.

Output 2.5: Multiple requisites of a National Framework for Climate Services, such as identification of stakeholders and information needs and implementation of national dialogs, have been addressed by ENANDES, thus contributing to NFCS implementation.

ENANDES will support the establishment of National Frameworks for Climate Services (NFCS) in Chile, Colombia and Peru. A National Framework for Climate Services is an institutional mechanism to coordinate, facilitate and strengthen collaboration among national institutions to improve the co-production, tailoring, delivery and use of science-based climate predictions and services by focusing on the five GFCS components. A sample institutional arrangement for an NFCS is displayed in Figure 16. ENANDES will yield real-world experience that will facilitate and advance considerably the operational implementation of NFCSs in accordance with GFCS Guidelines. The main functions of an NFCS are to serve as:

- An opportunity to bridge the gap between available climate services and user needs at national, subnational and local levels, continuously identifying user needs for climate services, communicating available climate products and services to users in the relevant sectors, and obtaining feedback from users on climate products and services.
- A vehicle for scientific coordination to synthesize the state of the climate at the national level, and distil climate knowledge outputs for policymaker actions founded on scientific evidence.
- An operational bridge between climate and sectoral research, NMHSs

Figure 16. Schematic representation of a National Framework for Climate Services showing the linkages among partner institutions acting together as one on climate knowledge. Source: WMO Step-by-step Guidelines for Establishing a National Framework for Climate Services.



and other relevant national institutions, to increase collaboration to improve services.

- A functional chain for linking climate knowledge with action on the ground so as to maximize the use of climate information and products by identifying bottlenecks to uptake of climate services.

Several requisites for the development of the NFCS will be explicitly addressed by ENANDES, such as (i) the identification and engagement of stakeholders in the water, energy and agriculture sectors, (ii) the establishment of a national dialogue around climate services provision, (iii) the identification of weather, hydrology and climate information needs and (iv) the preparation of a blueprint strategic Plan for the implementation of the NFCS in each country. Moreover, the knowledge management and communication strategy to be developed by ENANDES will have direct relevance for the design of NFCSs. In short, ENANDES activities, partnerships and agreements will help considerably the NFCS implementation process.

An equally important aspect of the NFCS process is the enhancement and development of Regional Climate Centers to help NMHSs to develop the technical capabilities required to produce effective climate services. Consequently, coordination activities undertaken by CIIFEN/RCC-WSA as part of ENANDES will be aimed at facilitating the national climate service processes. As planned in Outcome 4, all insights, best practices, and lessons learned will subsequently be transferred or scaled up to other contexts and institutions in South America.

5.2.3 Outcome 3: Engaged and empowered stakeholders have participated in the co-development and implementation of local plans and activities for adaptation to climate variability and change that rely on climate/water information.

Output 3.1: The factors that determine vulnerability to climatic variability and change have been identified for the sectors and regions targeted.

Only by tackling the social, economic, and cultural root causes of climate risks and vulnerabilities affecting communities in ENANDES countries can adaptation solutions be sustainable over time [81]. Climatic risks arise from the combination of hazards, exposure of people and assets to the hazards and their vulnerabilities and coping capacities at a particular location. Assessment of these risks at demonstration adaptation sites will require systematic collection and analysis of data.

The level of risk can change depending on the actual impacts and consequences of hazards. Therefore, the risk assessment will include an assessment of the community's coping and adaptive capacities. Risk assessments should be used to identify the location of vulnerable groups, critical infrastructure and assets, and to expand warning messages to include possible impacts. CIIFEN/RCC-WSA can contribute prior experience on climate vulnerability and risk assessments including social, economic and environmental variables and some proxies for adaptive capacity in several Andean countries [178].

Output 3.2: Capacity building and outreach efforts have improved the accessibility, comprehension and use of climate and water information for risk management and adaptation among local stakeholders and communities.

ENANDES will design and implement various activities to enhance the capacity and willingness of various types of stakeholders to access, understand and use climate information for management of, and adaptation to weather/climate hazards. There are many participatory methodologies that can be used and will be adapted and agreed to during the stakeholder workshops. One example are field schools that can be organized to increase the capacity of local authorities, boundary organizations and other stakeholders from each targeted sector/region to incorporate climate information into their decisions. Multiple participatory techniques will be used, such as the "dialog of knowledges" successfully applied for communication of health risks in Colombia [179]. The Mesas Técnicas Agroclimáticas – an adaptation proposed for all ENANDES countries (see Section 5.3.1) – will have similar purposes, serving as a useful vehicle for outreach, exchange of information and knowledge but, most importantly, as a built-in opportunity to sustain a dialog between climate service providers and users. WMO also has assisted NMHSs around the world in organizing Roving

Seminars on Weather, Climate and Farmers which make farmers more self-reliant by helping them become better informed about effective weather and climate risk management [180]. In the context of these Roving Seminars, WMO also provided low-cost rain gauges to farmers in order to help them learn about rainfall distribution and providing a supplement source of rainfall data.

A crucial design consideration for ENANDES is that most, if not all, planned activities should involve a two-way education between information producers and users. Climate information producers may assume that some piece of information is useful, but often they do not completely understand or know the potential users' decision-making processes and contexts, therefore the knowledge produced remains 'on the shelf' [181, 182]. Users, in turn, may not know or may have unrealistic expectations of how available knowledge fits their decision-making and thus choose to ignore it, despite its usefulness [24]. As a result of the two-way interactions among climate scientists and stakeholders proposed by ENANDES for all activities in this output, a realistic match between capabilities and needs should emerge gradually from this two-way learning process – users learn to expand the viable spectrum of decisions in response to new information while producers adapt products to the evolving needs of users – effectively enhancing the usability of climate information and knowledge [54, 183].

Other outreach and communication efforts will be designed and implemented with the purpose of sensitizing local communities to climate variability and change and their local/sectoral impacts. Insights from recent work on communicating climate change will be used to enhance increase users' understanding of this information, its strengths and limitations – despite recognizing that adoption of information depends on multiple factors and cannot be blamed on users' "ignorance" as perceived by information producers. Cognitive science shows that the way in which users process information, analytically or experientially, is important to their understanding and use of that information [184]. For example, relating new information to ensembles of relevant past experience and statistical constructs taps into an individual's analytical processing. On the other hand, relating new information to personal or others' experiences and memories engages one's experiential processing. Attending to these two kinds of processing equally during producer–user interactions improves communication of information, highlights relevant personal experience, elicits affective responses, and provides contextual meaning to information, thereby fostering usability [24, 52].

> *Output 3.3: Context-appropriate preparedness and adaptation plans and actions to reduce local damages from climate variability and change have been designed through participatory processes. Demonstration activities have been implemented and monitored to test those plans and actions.*

Step 1. This output will begin with a Project Inception Workshop (PIW) in each demonstration site. The PIW will bring together all relevant stakeholders in a demonstration area before adaptation actions are started. Through this workshop, stakeholders – including community women, elders and youth – and local leaders will build project ownership and identify priorities for the first year of implementation. The PIW also will aim to clarify the objectives and purposes of adaptation efforts, confirm engagement of key actors, and identify any previously unengaged stakeholders that should be approached.

Step 2. Co-design, implement and monitor a portfolio of context-appropriate plans and actions at different levels (from national and regional governments to firms and individuals) to mitigate damages from, and increase resilience to extreme weather hazards and climate variability in targeted sectors and regions. The design of adaptation activities should provide incentives for participation in risk management and adaptation actions by different types of actors. In particular, ENANDES will pursue actively the sustained engagement of women, elder, poor and vulnerable communities in all adaptation actions. Another aspect relevant to the design of demonstration actions is to encourage the engagement of the private sector in adaptation that so far has been relatively limited in ENANDES countries. As will be discussed, the demonstration adaptation activities proposed include partnerships with several actors from the private sector. *To facilitate the detailed explanation of demonstration adaptation activities, these are discussed separately in Section 5.3.*

Output 3.4: Early-warning systems and enhanced processes for inter-institutional coordination have (i) strengthened national/local management of risks and (ii) reduced the negative impacts of droughts and floods for demonstration adaptation sites/sectors.

ENANDES will implement hydro-meteorological forecasts and early warning systems, with an emphasis on flood- and drought-related risks. Early warning systems are major elements of disaster risk reduction. An EWS can prevent loss of life and reduce the economic and material impacts of hazardous events including disasters. EWSs can be considered as adaptation actions – and therefore could have been discussed with other demonstration adaptation actions developed by Output 3.3 and discussed in detail in Section 5.3. Nevertheless, they are highlighted as a separate output because of their importance for the project and because they will be a common adaptation activity across all countries.

There are existing frameworks on drought and flood management which the ENANDES countries can use as resources. WMO and the Global Water Partnership have established the Integrated Drought Management Programme (IDMP) [185, 186] and the Associated Programme on Flood Management (APFM) [187]. These programs have over 30 partners each working on these issues. For example, IDMP focuses on the three pillars of drought monitoring and early warning, vulnerability and impact assessment and mitigation and response. These pillars all contribute to developing drought policies and plans.

The climate diagnostics and seasonal forecasts discussed in ENANDES Outcome 1 will feed directly into the planned EWSs. These ENANDES activities may have strong synergies with other initiatives proposed by WMO that NMHSs plan to undertake. One example is the Climate Watch System that WMO proposes, which provides advisories to inform users, particularly those involved in natural hazards preparedness, mitigation and response, about evolving or foreseen climate anomalies. Nevertheless, either an EWS or a CWS will not only need climate monitoring and forecasting, but also an understanding of the likely impacts on sectors of interest, for instance to decide when to issue alerts or warnings. Consequently, EWSs need to actively involve the people and communities at risk from a range of hazards so they can help to select thresholds, indices, or criteria for warnings. Social actors also should be involved to facilitate public education and increase awareness of risks, disseminate messages and warnings efficiently, and ensure that there is a constant state of preparedness and that early action is enabled.

Effective EWSs integrate four main elements:

- *Risk knowledge:* Systematically collecting data and undertaking risk assessments.
- *Monitoring and prediction:* Developing hazard monitoring and early warning services, including weather and hydrological monitoring equipment, improving forecast capabilities and the use of these technologies within agricultural advisories, and drought and flood risk monitoring.
- *Dissemination of information:* Communicating risk information and reliable warnings to potentially affected locations through traditional and new media.
- *Response to warnings:* Building national, regional and community response capabilities to act effectively when warnings are received.

The EWSs proposed for ENANDES will interact with other planned adaptation activities such as the Mesas Técnicas Agroclimáticas (Section 5.3.1), where ongoing two-way dialog will help to progressively refine the design of EWSs by eliciting feedback from community leaders, small farmers (with particular attention to women and elders). The focus, characteristics and partners involved in the EWSs to be implemented or supported in the ENANDES countries are described in the following paragraphs.

Chile. The DMC will implement an EWS to manage the risks of droughts and water shortages in the Aconcagua River Basin (ARB) in partnership with the Ministry of Agriculture and the National Water Authority. The EWS will publish advisories and alerts about possible irrigation water shortages by monitoring rainfall in the middle and lower Aconcagua sub-basins and the extent and depth of snow pack that define flow in the upper Aconcagua sub-basin. Because irrigation in the ARB also relies on groundwater, the depth of the water table

will also be monitored. Monitored data (diagnostics) and forecasts will be disseminated to all relevant actors from both the water and agriculture sectors, from the national Dirección Nacional de Aguas to the Juntas de Vigilancia that monitor water allocation, and individual farmers.

Colombia. The EWS proposed for the demonstration sites in Popayán will focus on both droughts and floods. Admittedly, droughts are the main hazard in the drier Meseta de Popayán (Los Cerrillos). In contrast, in the more humid Río Piedras Basin both floods that are more common and droughts are important. Despite their lower frequency (at least historically), droughts may be important because the Río Piedras Basin is critical for the provision of water to the urban areas of Popayán. The local water company, Acueducto y Alcantarillado de Popayán - that will participate in ENANDES due to its linkage with the Río Piedras Foundation - is interested in monitoring watershed conditions that can have impacts on the water supply to Popayán, the capital city of the Cauca Department where about 260,000 people live.

Peru. This country plans to assess earlier EWSs located in the demonstration sites that are no longer active, and to select some of these systems that could be restarted with funding from other potential sources. Also, a preparatory step towards an EWS will focus on the prediction of floods in the Huallaga Basin, where the main hazard is flooding from river rise. There is preliminary work by SENAMHI to calibrate and validate a semi-distributed hydrological model (SWAT) that will subsequently be coupled with a hydraulic model to predict flood extent in the Huallaga Basin.

Output 3.5: Evaluations of the socio-economic benefits of ENANDES demonstration adaptation actions have been carried out.

National governments, NMHSs and funding/development agencies need to understand the socioeconomic benefits (SEB) provided by climate services, so that adequate financing can be mobilized and invested strategically to support the production and dissemination of those services [188]. Indeed, the relative lack of information on the economic impact of climate services appears to be one major factor that has limited investment in these services is [189]. Therefore, studies aimed at understanding the value and benefits of using weather and climate information can (i) justify investment in the provision of climate services; (ii) improve the existing provision of climate services to maximize use and value to users; and (iii) justify pricing if users are expected to pay for information [190]. Consequently, ENANDES will conduct a series of activities to estimate the SEBs of demonstration adaptation activities.

There are a number of methods and metrics that can be used to help understand the usability and value of climate services in decision-making [188, 191, 192]. Prior to the start of SEBs, CIIFEN/RCC-WSA will convene a workshop to review modern approaches to estimate the SEBs of climate information, and to assess their strengths and weaknesses as they apply to ENANDES sectors/areas. Recognizing the context-specific nature of the demonstration adaptation activities, the comparison of results from SEB studies would be simplified if a consensus approach were selected for evaluation.

Output 3.6: Useful lessons on local adaptation actions have been provided by an active project tracking effort (complementary to M&E efforts) that allowed active adaptation of goals, outcomes and outputs throughout the project.

Tracking adaptation progress is increasingly recognized as an important element of climate change adaptation. The Paris Agreement, adopted in 2015, stresses the need to monitor and learn from adaptation actions, and recommends periodical stocktaking of the overall progress towards climate change adaptation.

Tracking will be routinely carried out by project staff, project partners and capacity builders as they conduct their work. Some activities in this item may take place early in the project to help build or refine baselines to assess ENANDES progress. For example, baseline surveys will characterize current access to, and use of climate information in the demonstration sites, as well as any differences in these variables by gender, age or ethnicity.

5.2.4 Outcome 4: Regional and global coordination and cooperation mechanisms are strengthened; lessons, tools and approaches from ENANDES help others to provide climate services and replicate adaptation actions elsewhere.

The fourth and final ENANDES outcome seeks to enhance the coordination and interaction among all implementation partners in the project, other partners such as the WMO regional and global institutions and experts, and with external partners who may contribute expertise on specific issues. The component also will involve the synthesis and documentation of insights and good practices identified during the project, so that lessons learned can be transferred for replication or scale-up to other contexts in South America and elsewhere. ENANDES Outcome 4 will rely heavily on the coordination role of CIIFEN/RCC-WSA.

Output 4.1: Regional coordination activities like syntheses of surveys and needs, and regional expert meetings have been carried out to support the update of national climatic and hydrological data management systems, and the implementation of interoperable regional databases.

CIIFEN/RCC-WSA in collaboration with relevant WMO entities will synthesize the baseline status surveys performed by each NMHS in order to identify common needs for climate and hydrological data management capabilities. The coordination does not seek to impose one common data management solution to all NMHSs but, instead, to enhance economic efficiency through collaborative solutions that address identified common needs.

Another data-related function that CIIFEN/RCC-WSA will perform would be to complement and facilitate the work of NMHSs will be the identification and archival (including providing simple access methods) to key existing high-resolution global or regional gridded climate datasets. The Peruvian experience on production of gridded data should be capitalized during ENANDES. Finally, this output will include the compilation and indexing of a digital repository of technical publications – produced by WMO or other relevant agencies – on the regional climatology of western South America.

Output 4.2: Regional coordination activities like consultations and expert meetings have been carried out to support and complement national strengthening of capacities for climate monitoring and prediction.

Most activities in this output will involve the coordination and facilitation of collaboration among ENANDES countries and – if deemed necessary by ENANDES countries – with external partners to produce sub-seasonal to seasonal forecasts of regional climate conditions. The activities to produce and assess these forecasts are described in Section 5.2.1, Output 1.4.

As part of this output, CIIFEN/RCC-WSA will develop a system to facilitate one-stop access by all ENANDES institutions to the seasonal forecasts and climate change projections produced by multiple regional and international institutions such as WMO's Global Producing Centers for Long-Range Forecasts (GPCLRFs) for seasonal forecasts, or the Earth System Grid Federation (ESGF, esgf.llnl.gov) for climate change projections. A repository will be created by ENANDES documenting the main characteristics of each group of climate projections and providing links to additional details. The system will include simple tools to select specific regions and extract desired climate variables from global fields so that further analyses can be conducted. The global repositories include tools to facilitate data manipulation.

Output 4.3: Regional coordination activities like consultations and expert meetings have been carried out to support and complement national strengthening of capacities for climate services production, dissemination and uptake.

This output will involve a suite of three activities sharing the overarching purpose of contributing to enhance the production, dissemination and use of climate services among ENANDES countries. The first activity will include technical advice and guidance provided by CIIFEN/RCC-WSA for the implementation of groups of local volunteers – in locations where they are desired or needed – to provide weather and water observations to complement official observation networks considering the outcomes of the observation network

assessments (Output 1.1). Volunteer networks not only have the advantage of providing additional data in locations with sparse observation stations, but also serve a useful purpose in engaging social actors in the weather/climate, providing them with useful information on their local conditions and a sense of ownership about observations. Earlier experience with volunteer observers exists in the ENANDES region. For instance, ENANDES partner Fundación Río Piedras and CGIAR CCAFS collaborated in the implementation of a volunteer network in Popayán, Colombia (one of ENANDES local adaptation sites) [139], where members of indigenous and peasant communities were given a rain gauge and maximum/minimum thermometers to record daily weather and produce regional maps of the observed variables (Figure 17). This effort was part of a project to develop a participative early-warning system for agroclimatic events (SAATP or "sistema de alertas agroclimáticas tempranas participativas"). The SAATP focused on monitoring local climatic conditions and the use of good environmental practices for water and associated risk [193]. This early system brought together local town and municipal councils, small farmers associations, community action groups, and leaders of the indigenous resguardos. The volunteer networks may not only include civil society institutions: in Chile, the Chilquinta power generating company approached the DMC to collaborate in implementing a network of meteorological stations within the area served by the company.

Figure 17. Volunteer weather observers in Popayán, Colombia. Top: low-cost rain gauges distributed to observers. Middle: community discussion of observations. Bottom: workshop for discussion of community-sourced weather maps. Source: Iragorri Velasco, 2015.

The second activity will involve a workshop to review state-of-the-art approaches for the estimation of socio-economic benefits (SEBs) from demonstration adaptation interventions. The workshop, with participants from ENANDES countries and potential external partners, will seek to reach consensus on methods to be used for SEB estimation in demonstration adaptation areas so that results can be compared. Once a consensus approach is chosen, SEB studies will be carried out (Output 3.5).

In the third activity of this output, CIIFEN/RCC-WSA will develop an online collection of best practices and lessons-learned on the implementation of climate services delivery at regional, national and local level.

Output 4.4: Regional Technical Working Groups have been re-convened, revitalized or established. Active liaison with other ongoing projects in the region has achieved positive synergies and enhanced economic efficiency.

This output will involve a range of activities by CIIFEN/RCC-WSA to coordinate and strengthen technical cooperation among ENANDES countries and other countries in the region. A first activity will seek to invigorate regional Technical Working Groups (TWGs) that exist under the aegis of WMO's Regional Association III but have had limited recent activity. If additional TWGs are needed on topics not covered to date, they may be convened. This effort also will seek to strengthen interactions among disciplinary scientific communities, such as climate and hydrology experts.

The coordination efforts will support some of the activities already described. For example, CIIFEN/RCC-WSA will launch a regional TWG to coordinate the assessment of skill (or performance) of S2S forecasts of regional climate to be produced by ENANDES countries (see Output 1.4) using established procedures and metrics. This Working Group also may be tasked with proposing appropriate procedures for downscaling S2S forecasts in space and time.

Finally, ENANDES coordination efforts may include (i) sharing and communicating ENANDES results across those countries that are members of the RCC-WSA but are not participating in ENANDES (Venezuela, Ecuador and Bolivia); (ii) liaison with other climate-related projects in the region, such as those funded by the European Union through Project Euroclima+ 2018, or the planned "Post-Climandes Initiative" that is currently under consideration by the Swiss Development Agency); (iii) fostering fluid communication and exchanges with other WMO Regional Climate Centers in South America, such as the RCC-SSA that covers southern South America); and (iv) provide liaison with other WMO entities such as the Global Producing Centers of Long-Range Forecasts and Regional Training Centers (more on this below).

Output 4.5: An ENANDES Climate Services Toolkit (CST) has been implemented that is tailored to the previously determined operational needs of ENANDES NMHSs.

ENANDES will place a strong emphasis on fostering effective and productive collaboration, fluid interactions and shared learning among the three participating NMHSs and CIIFEN/RCC-WSA. This output is an important step towards that goal, as it seeks to encourage the joint development of a set of climate and water analysis and visualization tools to be used in ENANDES activities first, and subsequently shared with countries in the region and elsewhere.

This activity seeks to organize all tools and procedures developed by ENANDES into what is referred to as an ENANDES Climate Services Toolkit (CST). A CST is a suite of data, software tools, training resources, and examples that serve as a starting point and a reference tool for enabling climate services at global, regional, and national levels. The ENANDES CST, for example, may include tools developed for climate monitoring, such as the calculation of anomalies, percentiles and return periods of climate elements, or computation of indices for drought monitoring purposes. The CST might include forecasting, downscaling and verification tools.

The joint development of analytical tools will not only raise the capacity of all NMHSs by sharing learning and drawing on each other's strengths, but also will significantly improve the economic efficiency of ENANDES, as development costs will be shared and duplicated efforts avoided. Economic efficiency will also be enhanced by reducing the need for expensive capacity building through availability of training resources. A CST will also make training workshops more focused, tangible and efficient in imparting operational skills.

CIIFEN/RCC-WSA will coordinate the shared development of an ENANDES CST by supporting an experienced scientific programmer or software engineer or who will help define common coding style guides and standard documentation templates to facilitate sharing of ENANDES-developed tools among all participants.

Output 4.6: Capacity building efforts for ENANDES have been (i) defined by ENANDES participants, (ii) coordinated by CIIFEN/RCC-WSA and (iii) jointly planned and implemented by countries and WMO Regional Training Centers, WMO Training Activities Division and other institutions.

The ability of an NMHS to carry out its role of national observations, data collection and delivery of climate services depends on the infrastructure and human resource capacity available to it. Capacity development is a strategic priority within WMO, as it is critical to enhancing the capabilities and capacities of NMHSs to improve the quality and delivery of climate services [194]. It should be stressed that Capacity Development is also an all-encompassing GFCS pillar which interacts strongly with the others to achieve the framework's objectives (Figure 2).

All ENANDES training activities will be formally coordinated, conducted and assessed by the WMO Iberoamerican Regional Training Centers and WMO's Training Activities Division. The RCC-WSA will provide the funds for planning, execution and the consequent assessment of the training required by the ENANDES participating countries using widely accepted procedures and metrics.

The ENANDES budget request for this component covers both the development, implementation and post-course impact evaluation of about five courses, of which three will be classroom-based and two will take

place online). Topics to be addressed, however, have been left undefined on purpose in order to retain flexibility until consensus on training priorities and needs is reached by ENANDES participants; the topics may consider also capacity needs identified by the AR III. Some funds may be allocated to scholarships to participate in formal training efforts, such as the recent "Diploma de Postgrado en Servicios Climáticos" program developed by the Universitat Rovira i Virgili, Tarragona, Spain. The high priority that ENANDES partners place on this component is illustrated by the fact that they all have agreed to establish a "common fund" for capacity building, to which they will contribute equally; the use of these common funds will be selected by consensus among partners.

The ENANDES capacity building efforts will seek to develop the Human Capacity for climate service providers; training for other types of users (e.g., government administrators) will be addressed by other components (e.g., field schools). Not many training efforts have been focused on this topic; exceptions include the multi-part training course developed by SENAMHI during the Climandes Project and the distance training courses developed by IBIMET, a WMO RTC in Italy (ibimet-rtc.mlib.cnr.it). As new curricula and competencies for climate services are designed, educators should keep in mind that a multi-disciplinary skill set will be necessary. Human capacities needed include management and leadership skills that will enable NMHSs to develop stronger political support, develop relevant policies and legal frameworks, and enhance sustainability by linking regional, sub-regional and national planning processes.

All training efforts will be formally assessed by experts in the WMO Iberoamerican RTCs, WMO's ETR or other external institutions using widely accepted procedures and metrics. The funds to support the assessment are included in the amount assigned to the CIIFEN/RCC-WSA. A rigorous evaluation of the training process is required to occur at the following four levels (www.kirkpatrickpartners.com).

- Level 1: **Reaction** refers to the trainees' opinions of the effectiveness and value of the training. ENANDES will conduct standard reaction surveys at the end of training events to help improve the learning experience for future students.
- Level 2: **Learning** by trainees is assessed to determine if expected learning outcomes were met. Learning assessment will be part of each ENANDES training event, and should be aimed not merely at recall of information, but at the skills to produce and deliver climate products and services based on the procedures taught.
- Level 3: **Behavior**, or application of learning demonstrates how well the learning outcomes are willingly and ably applied on the job. ENANDES must demonstrate that training interventions, as well as the other project components, are able to change job performance. This evaluation must occur after there has been sufficient time to apply learning.
- Level 4: **Results** are the impacts on the organization of the training through the improved service delivery. For ENANDES, this is identical to the evaluation of the project outcomes themselves, and is discussed elsewhere in the proposal.

5.3 Description of Demonstration Adaptation Activities

This section will discuss the demonstration adaptation activities to be co-designed, implemented and assessed in various sites of ENANDES countries. The adaptation activities are described in this section for convenience, but they conceptually belong as part of Output 3.3. There are two common activities that will take place across all ENANDES countries: the Mesas Técnicas Agroclimáticas and early-warning systems for floods/droughts. Country-specific adaptation actions are subsequently discussed.

A central design consideration for *all* proposed adaptation activities is that they will be designed and implemented as a close partnership between NMHSs and appropriate partner institutions. The partnerships not only will supply the necessary sectoral expertise and stakeholders' trust, but also will be key to the future sustainability of ENANDES activities. For example, Colombia's Ministry of Agriculture has been supporting the Mesas Técnicas Agroclimáticas for several years. If ENANDES partners with this Ministry, it is reasonable to

expect that support will continue, particularly if the approach is revised and enhanced. Similar partnerships will be established for other adaptation activities with the institutions responsible.

5.3.1 Mesas Técnicas Agroclimáticas 2.0

An adaptation action planned for all three ENANDES countries involves the Mesas Técnicas Agroclimáticas (MTACs), also referred to as Local Technical Agro-Climatic Committees (LTACs) [160]. About six years ago, Colombia's Ministry of Agriculture and the CGIAR CCAFS launched the initial MTACs in two regions of that country, the mountainous Andean region (Cauca) and the coastal plain (Córdoba). Colombia clearly has the expertise on this activity. Indeed, a couple of years ago the Chilean Ministry of Agriculture asked for assistance from Colombian experts to implement MTACs just south of the ENANDES site in the ARB.

How does an MTAC work? Briefly, the approach involves periodic meetings (e.g., monthly) with the participation of local stakeholders, farmers and the private sector, as well as research organizations and national and local government institutions. All these actors engage in discussions on how best to manage crops and farms in a specific location at a specific time. Various entities provide critical inputs into the discussions. For example, the NMHS and international/national technical agencies provide diagnostics of recent climate and hydrological conditions, and forecasts of likely climate scenarios. Using crop models (if available) and/or local farmer and expert knowledge, crop choice and management options are assessed in the light of likely climate scenarios. Farmers then use this knowledge to make better, informed decisions on how to manage their farms [160].

There are six basic components required to implement the MTAC approach to bridging the gap between climate science and farmers: (i) establishment of the MTAC with alignment of local parties interested in managing climate variability and definition of their roles; (ii) local climate diagnostics and monthly climate forecasts; (iii) exploration (model-based or using expert judgment) of the outcomes of expected climate and alternative managements on crop production, processing, and marketing; (iv) two-way discussion among scientists, experts, and farmers [141, 160].

Why Mesas 2.0? The Colombian Ministry of Agriculture has been funding the MTAC process since its inception. Nevertheless, Colombian ENANDES collaborators reported the perception that the process has become somewhat stale and is ready for enhancements. Given the climate diagnostics and forecasts to be strengthened by Outcome 1, together with the strong ENANDES emphasis on understanding how to sustain dialogs with stakeholders offer the opportunity to refresh and update the MTAC process. It should be noted that one of the NDCs proposed by Colombia sets the target of reaching *"participation of 15 departments[2] in the Mesas Técnicas Agroclimáticas and one million farmers receiving agroclimatic information"* by 2030.

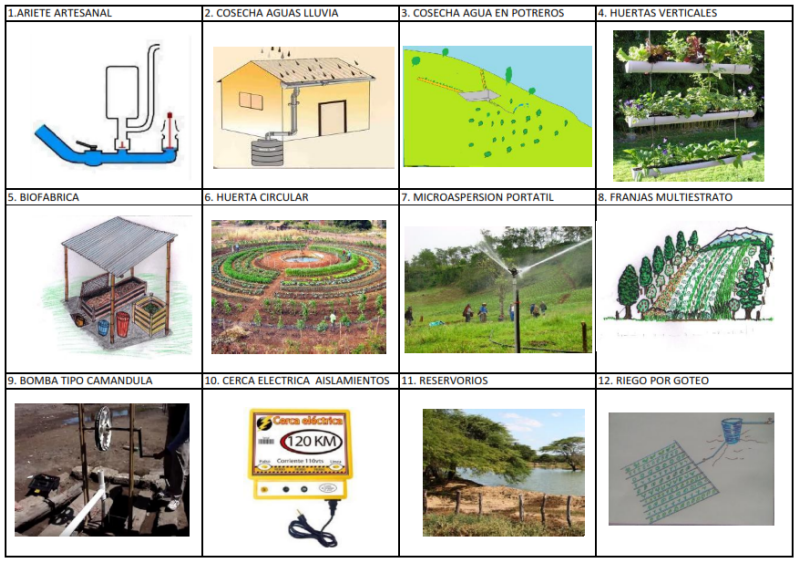
5.3.2 Other Adaptation Activities in Chile

Support to the Energy Sector. Energy generation and planning of operations are markedly affected by meteorological events and energy systems are increasingly exposed to weather and climate affecting both energy supply and demand. By taking into account weather and climate information, energy systems can considerably improve their resilience to weather extremes, climate variability and change, as well as their full chain of operations during their entire lifecycle [195]. As part of the demonstration activities, the DMC will work with the National Electricity Coordinator, the entity that regulates dispatch and assigns production quotas to each generating unit in Chile. The DMC will work with the Coordinator to explore how operations could be improved by access to weather and climate information on scales from days to seasons. Some of the possible applications listed by the Coordinator include (i) monitoring of snowpack extent and depth in the Andes highlands; (ii) forecasts of temperature on scales from a few days to seasons; (iii) forecasts of cloud coverage or solar radiation and winds for solar and wind energy generation. Other consultations were held with different stakeholders, including (a) distribution and transmission companies, (b) the Association of

[2] Level 1 administrative units in Colombia.

Small Power Generation Plants, and (c) ACERA, the Chilean Association of Renewable Energy. The Ministry of Energy agreed to collaborate with ENANDES in a range of activities to (a) enhance access to relevant climate information by stakeholders from the energy sector; (b) jointly develop a range of forecast products that would serve the needs of the sector; (c) implementation of a Mesa de Energía, an analog to the MTACs, where current conditions and outlooks would be discussed between DMC, the Ministry and stakeholders.

Figure 18. Farm-level adaptation activities explored in earlier projects by ENANDES collaborators; some of these will be investigated in this project. Source: Fundación Ecohabitats.



Contributions to the Observatorio Agroclimático. The climate diagnostics and forecasts to be produced by ENANDES will be used to augment the contents of the existing Observatorio Agroclimático, a system of agroclimatic information currently operated by the Ministry of Agriculture (agroclimatico.minagri.gob.cl). ENANDES will assist the Observatorio to make any new indices or products available to users.

5.3.3 Other Adaptation Activities in Colombia

Sistema de Información para la Gestión de Riesgos Agropecuarios, SIGRA. The Rural Planning Unit (Unidad de Planificación Rural Agropecuaria, UPRA) of the Ministry of Agriculture and Rural Development is starting the development of an information system to manage agricultural risks (SIGRA) of different kinds, from climate to commodity price fluctuations. As the system is currently being designed, ENANDES agreed to partner with UPRA – a different and semi-independent section of the Agriculture Ministry that funds the Mesas Agropecuarias – to explore how climate services and information be incorporated to the SIGRA functionality.

Feasibility of Photovoltaic Installations for Rural Areas. Many rural areas in Colombia (including parts of the adaptation area in Cauca) do not have access to the country's Interconnected Electricity Grid. Given technological advances and cost reductions in solar electricity generation equipment, it may be more cost effective to provide electricity to rural areas through small photovoltaic installations (capable of supplying power small hamlets of 8-12 households) than to link these areas to the power grid. ENANDES will partner with the Ministry of Mines and Energy to explore this adaptation. ENANDES will install observation equipment to refine estimates of solar generation potential in the demonstration sites, and the Ministry will help assess the enhancements to quality of life of rural households through access to solar energy – the Ministry already has developed such indicators. Moreover, there has been discussion of the Ministry of Energy providing ENANDES with a few photovoltaic installations free of charge.

Farm-scale adaptation actions. In partnership with Fundación Río Piedras and Fundación Ecohabitats, ENANDES will extend earlier programs by these NGOs in collaboration with CCAFS to explore farm-level actions to adapt to extreme weather, climate variability and change (Figure 18). Some of the earlier activities tested that might be revisited by ENANDES include the harvest of water, efficient irrigation techniques, in-farm reservoirs and others.

5.3.4 Other Adaptation Activities in Peru

Peru intends to undertake various activities that will support the implementation of adaptation actions identified as priorities by stakeholders from the agriculture, energy and water sectors. In particular, the actions highlighted in this section will directly support Peru's recently-defined NDCs.

Assessment of Peru's hydropower potential. As discussed above, Peru has a largely untapped potential for hydroelectricity generation. Various hydrological basins will be studied to determine their hydropower potential and their vulnerability to climate change. Recent advances in remote-sensing, geographic information systems and hydrological modelling provide realistic, up-to-date and useful information for the assessment of hydropower potential. This is an adaptation action that has been requested by the energy sector, as the information will be crucial to help define a robust portfolio of hydropower projects.

Agroclimatic zoning in the Huallaga Basin. The agroclimatic zoning will allow the diversification of crops in the Huallaga Basin, incorporating crops that are less sensitive or vulnerable to climate change. This adaptation action has been requested by local stakeholders during recent consultations. The results of this task will inform the production of agroclimatic information and services, critical for adapting to climate variability and change.

6 Innovative Contributions of ENANDES to Climate Variability/Change Adaptation (B)

ENANDES will trigger a major leap in the capacities of participating NMHSs to produce and communicate timely, relevant and sector-tailored climate and water services to inform decision- and policy-making on preparedness for, and reduction of damages from climatic hazards. The main innovation is that the suite of climate products and services to be provided will respond to needs elicited from the participating communities and vulnerable groups, and will be tailored to be consistent with existing decision needs and protocols of different actors/sectors.

Nevertheless, because ENANDES acknowledges that climate information by itself is not sufficient to foster adaptation, the project also will aim to build institutional capacity and enhance coordination, overcome technological and cultural barriers to use of science evidence, and stimulate social learning for multiple actors such as communities, resource managers and practitioners, firms, and individuals. To achieve this goal, during project design ENANDES has developed innovative partnerships with a diverse spectrum of institutions, from national governmental agencies and ministries to regional authorities, non-governmental organizations and actors from civil society, including indigenous populations and organizations of small farmers. At the same time, the broad national and international network of partners– including direct involvement of multiple governmental institutions in adaption activities – will facilitate mainstreaming (i.e., the replication and scale-up) of adaptation activities while, simultaneously, contributing to sustainability of the project.

ENANDES will accelerate the implementation of a non-traditional type of institution: national frameworks for climate services. Moreover, ENANDES will contribute to NFCS development in an innovative manner: it will *complement* the top-down process outlined in WMO guidelines with bottom-up, real-world lessons from the proposed demonstration adaptation projects in diverse contexts and regions. The adaptation activities not only will make tangible contributions to local resilience in demonstration sites, but also will be important contributions to the development of climate services. These services will facilitate the implementation of NDCs for which climate information is considered as an enabling condition[3].

[3] Enabling conditions are defined as actions that facilitate the implementation of mitigation and adaptation actions. These are not only related to technical information, but also include institutional arrangements, capacity building, research and development, and norms and regulations, among others.

The diverse network of ENANDES implementing partners, together with the project's appreciation of the multiplicity of contexts that influence the impacts of climatic hazards, motivates an explicit recognition of the interdependent nature of climate-related risks to livelihoods and infrastructure. The integrative approach proposed by ENANDES, therefore, contrasts with the siloed approach to water, energy and food that is typical of many national policies, plans and strategies that set out the vision of governments over a 10-30 year horizon. The integrative ENANDES perspective will facilitate the assessment of necessary economic and social trade-offs between water, energy and food under different current and climate scenarios, and the subsequent policy responses.

"Twinning" is an instrument for building institutional capacity that has been used often as an innovative means for building and strengthening institutional capacity. Twinning can be defined as a "process that pairs an organizational entity in a developing country with a similar but more mature entity in another country" [196]. A recent example has been the Climandes Project, which involved twinning between Peru's SENAMHI and the Swiss meteorological agency, MeteoSwiss. *ENANDES proposes an innovative twist on twinning,* by extending the concept to all three ENANDES NMHSs – the proposal will refer to this process as *"tripletting."* The innovation is not only in the number of partners involved but, instead, on the fact that there are no obvious asymmetries in the capacities of the three NMHSs. If the NMHSs' capacities are comparable, how can they benefit from the tripletting? First, an *overall* evenness in capacities does not imply that an institution cannot have *specific* strengths that may help overcome weaknesses in its partners. Second, even with comparable capabilities, chronic personnel shortages imply that an institution often has few experts working on a topic. By stimulating regional collaboration facilitated by virtual interactions and in-person visits, ENANDES will build a critical mass of regional experts who have developed trust and a common language, and who are used to work and learn together.

7 Economic, Social and Environmental Benefits of ENANDES (C)

Climate is becoming an increasingly important element of the public and private decision-making process. More and more, decision makers at multiple levels – households, communities, regions and countries – will need actionable scientific evidence and information to enhance their capacity to respond to the challenges posed by climate variability and change.

ENANDES aims to increase societal and community resilience by improving weather and climate diagnostics and forecasts/projections enhancing their communication and utility in social, economic and environmental applications [188]. Enhanced access to tailored climate information and services, therefore, will enable individuals, households, organizations, businesses and governments to take decisions which reduce the impacts of natural hazards, enhance the safety and convenience of daily life, increase business profitability, address the challenges of public health and poverty alleviation, improve productivity, strengthen national economies, protect the environment and provide evidence for future planning [188].

It follows from examination of Figure 1 that value is only realized once climate information is collected, processed, delivered and a decision or action is taken based on the information. It follows that the more climate services and information are used, the more value they will deliver. Consequently, ENANDES will follow multiple avenues – from "field schools" to co-design of adaptation actions with relevant stakeholders – to increase climate service uptake and societal value. Sustained dialog with users will seek to minimize the chances that information is misunderstood or misinterpreted, leading to poor decision making and to negative value.

The EWSs proposed will be a major contribution of the project to the attainment of economic, social and environmental benefits. In many parts of the world, the usual approach to climatic hazards such as droughts and floods is *reactive*, responding to events *after* their impacts have occurred – commonly referred to as "crisis management" [197]. Responses to an ongoing crisis often involve emergency aid programs to provide tax relief, money or other specific types of assistance (e.g., temporary housing, livestock feed, etc.) to the victims. Admittedly, emergency drought relief remains necessary, as it addresses urgent humanitarian needs. Nevertheless, reactive responses to crises often can be untimely, poorly coordinated, and unnecessarily expensive [198]. In contrast, EWSs – when coupled with national, regional and community preparedness protocols and response capabilities – allow proactive responses to climatic hazards, not only allowing mitigation of potential negative impacts from hazards, but also avoiding post-event haphazard reactions.

EWSs also can generate long-term economic and social benefits. In the long term, emergency assistance does not contribute to reducing the vulnerability to drought of the affected societies. Instead, emergency assistance may actually *decrease* the coping capacity of individuals and communities by inducing greater reliance on these interventions, rather than increasing self-reliance. In contrast, planning and preparedness actions aimed at managing climatic risks – elements of an EWS that are as important as monitoring weather and climate – can have substantial co-benefits and positive social returns, even without high-impact events. Indeed, such actions can be promoted widely as low- or no-regret strategies for sustainable development and building resilience to a variety of environmental, economic and social shocks [199].

Consultation with ENANDES countries yielded a list of expected benefits (Table 7).

Box 1. Evidence of Economic Benefits of Climate Services in the ENANDES Region.

Already there is evidence of the economic benefits of climate services in the ENANDES region. As part of the 2014 regional "Programme to Strengthen Weather, Water, Climate Services and Development in the Andean Region," PRASDES (www.prasdes-ciifen.org), CIIFEN estimated the socio-economic benefits of weather/climate information in Puno, Peru. The losses avoided from adverse weather and climate events were twice as large as the cost incurred by the Peru's Government to maintain SENAMHI's Puno office.

Outbreaks of the plant disease known as coffee rust have affected every coffee-producing country in Latin America. Infections were amplified by unexpectedly warm temperatures and intense rainfalls. Information on future climate and weather conditions has a strong potential for enhancing farmers' adaptation strategies (e.g., by preventively applying costly fungicides) and thus reducing economic losses. Lechthaler & Vinogradova (2017) estimated the value of climate information for coffee farmers in Cusco, Peru at ≈21.1 USD ha^{-1} $year^{-1}$ and 1.24 million USD for the Cusco region.

THE CLIMANDES Project in Peru conducted studies to provide initial estimates of the socio-economic benefits of various climate services. One of these services, a frost warning for quinoa in the Puno region, had an estimated value for the entire region of about 2.7 million USD.

Table 7. Social, economic and environmental benefits expected by each ENANDES country

Economic benefits	Social benefits	Environmental benefits
Chile		
Reduced losses and damages from hydro-meteorological and climate extreme events. Increased economic competitiveness based on climate-smart production (agriculture, energy). Increased economic growth associated with enhanced resilience to climatic hazards.	Improved capacities at national and local level to cope with adverse weather and climate events, with lower negative impacts on the livelihoods of highly vulnerable families and communities. Improved quality of life due to increased safety for communities and property. Reduced chances of abrupt job losses or negative effects in communities' livelihoods.	Improvement in practices for use of agricultural fertilizers, reducing the amounts used and thus the risks of eutrophication in groundwater and water bodies and streams. Improved practices for water resources. Increased use of hydroelectric power and renewable sources (wind, solar).
Colombia		
Reduction of production cost through better agricultural planning, crop, soil and water management, scheduling of sowing and harvesting activities, and management of applications of insecticides/pesticides. Efficiency in the generation of climate information products, as they explicitly address the expressed needs of users. Clean energy projects based on information of water availability at the intervention area. Improvement of the local economy through energy savings by reducing both consumption and operation and production costs.	Reduction of climate extreme events that impact food security and water availability. Renewable energies improve quality of life for households or villages not connected to the national grid. Simultaneously, providing electricity to those areas through local generation is less costly for power companies. The Project will provide key information for system design and technological solutions applied to energy issues to enhance quality of life.	Land use planning improved with environmental aspects, such as: water resources management, renewable energy, disaster risk management, conservation and exploitation of biotic and edaphic resources. Reduction of issues that increases climate change impacts and disaster risk factors. Improvement of natural resource management that preserves ecosystem services and environmental quality.
Peru		
Through timely access to hydro-meteorological warning and/or weather forecasting information for planning purposes, preventive risk management actions and adaptation measures will be developed that will contribute to reducing impacts and damage to crops, livestock, energy infrastructure (production, transmission, distribution, etc.), as well as optimal water resource management. Avoided costs include costs associated with emergency response, rehabilitation and restoration of operational capacities.	The populations are more aware of climate variability and change, and have more information on response mechanisms. This will strengthen the participation of the population (the most vulnerable communities that include women and elders) in decision-making related to agricultural production and risk management and organized society. Development of a culture of preparedness and commitment to proactive disaster risk management.	Reduced damage and losses to populations, livelihoods, and also ecosystems that are part of the production systems of rural populations. The negative effects of extreme events are managed through adaptation measures that aim to maintain and conserve ecosystems and their ecosystem services (agro-biodiversity, water-regulating water services for the provision of water for irrigation and/or sustainable energy generation), as well as to mitigate their negative impacts.

7.1 Expected Benefits of ENANDES to Vulnerable Communities and Groups

7.1.1 Indigenous and Peasant Communities

ENANDES will actively seek the active engagement and participation of vulnerable communities in all project activities. The project is consistent with the rights and responsibilities set forth in the UN Declaration on the Rights of Indigenous Peoples and other applicable international instruments related to indigenous peoples.

It is of great importance for the project's ultimate success to take into consideration indigenous groups and peasant communities within the demonstration sites: the current activities, needs and concerns of these groups are key for the co-design of viable adaptation actions. The preparatory consultation process found that the involvement of both of these groups would enhance considerably the potential for scaling up community-based adaptation solutions.

The description of demonstration adaptation sites (Section 3.3) showed a presence of indigenous populations in the Colombia sites (Popayán) and Peru (particularly in the Huallaga Basin). In Colombia, indigenous indigenous families from the Páez ethnic group and the Coconucos ethnic group have their own land ("resguardos") and have community organizations ("cabildos") that will serve as helpful boundary organizations to work with these populations. Collaborating NGOs in Popayán have worked with indigenous and peasant communities for several years, thus have earned considerable credibility and trust. The Popayán site also includes a relatively smaller proportion of Afro-Colombians. The definition of "indigenous peoples" in Peru has cultural/historical connotations. In the Rímac adaptation site, the population addressed will be Andean/rural communities or organized populations vulnerable to the impacts of extreme hydrometeorological events. In the Huallaga Basin, the second Peruvian site, the ethnic composition of the population is quite diverse. In Chile, 12.8% of people consider themselves belonging to an indigenous or native people, but the region of Valparaíso is well below the national average (6.8%). In the Aconcagua basin, however, there are many small farms that resulted from an agrarian reform process.

One common aspect of most demonstration adaptation sites is the presence of a large proportion of people in poverty. In most of the adaptation site, smallholder agriculture is a common activity. As ENANDES will foster the use of climate services and adaptation practices (e.g., the Mesas Técnicas Agroclimáticas) to increase agricultural incomes and reduce their dispersion (i.e., the large fluctuations between good and bad years), smallholders should benefit directly from this project. The project's products will be widely disseminated locally through regional offices of the Ministries of Agriculture in order to make the information available to smallholders and the advisors and extension agents that support them through the promotion programs of territorial units at the community level. This is expected to reach the largest number of users and beneficiaries in the territory. One of Colombia's NDCs aims for one million farmers country-wide to receive agroclimatic information by 2030.

Table 8. Human Development Index (HDI), Gender Inequality Index (GII) and Gender Development Index (GDI) for the three ENANDES countries. Values correspond to 2017 (Source: United Nations Development Program, UNDP; values downloaded from hdr.undp.org).

Country	HDI		GII		GDI
	Value	Rank	Value	Rank	Value
Chile	0.843	44	0.319	72	0.961
Colombia	0.747	89	0.383	87	0.997
Peru	0.750	90	0.368	83	0.950

7.1.2 Gender Dimension and Perspective

Gender equality and social inclusion are crucial for ENANDES adaptation actions to yield desirable outcomes such as increased production, improved outcomes for poverty alleviation, increased well-being for all, and a fairer distribution of burdens and benefits of target sectors among women and men. While ENANDES climate services aim to enhance the adaptive capacities of communities and households, women and men can face different opportunities and challenges to access and use these services. For example, women and men farmers can be differentially vulnerable to climate-related risks, partly because of the roles and responsibilities of each gender. ENANDES will seek to understand gender differentials in the access to, and use of climate information, and to determine the factors and conditions that can enable climate services to ameliorate gender inequalities.

International indices show marked gender inequalities in human development in the three ENANDES countries. Table 8 shows the Human Development Index (HDI), Gender Inequality Index (GII) and Gender

Development Index (GDI) for the three ENANDES countries in 2017. The HDI emphasizes that people and their capabilities should be the ultimate criteria for assessing the development of a country, not economic growth alone. *The GII is an inequality index that measures gender inequalities* in three important aspects of human development: reproductive health, empowerment, and economic status. The higher the GII value, the more disparities between females and males and the more loss to human development. *The GDI measures gender gaps in development achievements;* it is calculated as the ratio of the HDIs calculated separately for females and males. ENANDES countries have wide gender gaps (Table 8).

ENANDES is committed to ensure that the Project effectively includes a gender perspective. A baseline will be established to characterize the participation and roles of women and men in resource management and in the access to, and use of climate information for decision-making. Existing empirical research related to gender and climate services will be reviewed to understand how gender influences benefits derived from climate services. For example, a survey by CGIAR CCAFS explored gender issues in smallholder farms in Popayán, Colombia: results suggested that women were more likely than men to adopt climate-smart agricultural practices and to use climate information to plan agricultural activities [138]. Other proactive measures to ensure gender equity – such as establishment of an ENANDES "gender equity committee" – are discussed in the section on project risks and are included in Output 3.3. Minimum participation quotas will be established for women in the workshops, providing any necessary logistics to encourage for their participation. The engagement of women's groups in leadership will also be promoted through participatory teamwork, seeking to support the associativity of vulnerable rural communities. Last but not least, ENANDES will ensure the equitable representation of women *within project implementation partners* (NMHSs, ministries, NGOs, etc.).

8 Cost-effectiveness of Project ENANDES (D)

A quick review of country plans and legislation to address climate variability and change, as well as NDCs reveals that many countries share common adaptation concerns. Countries within a given sub-region (such as ENANDES participants) are further likely to share common climate characteristics (e.g., ENSO-related variability). Therefore, effective adaptation measures developed in any country in the sub-region, and the decision-support products necessary to implement those measures, are likely to be applicable in other countries across the sub-region. By providing coordination and facilitation of interactions and sharing of expertise, ENANDES will increase the efficiency of funding for adaptation in the region.

A specific example is the proposed joint development of a set of climate and water analysis and visualization tools to be used in ENANDES activities and subsequently shared with other countries in the region and elsewhere – these tools and procedures will be organized in the framework of a regional "Climate Services Toolkit" (CST).The joint development of analytical tools will not only raise the capacity of all NMHSs by sharing learning and drawing on each other's strengths, but also will significantly improve the economic efficiency of ENANDES, as development costs will be shared and duplicated efforts avoided. Economic efficiency will also be enhanced by reducing the need for expensive capacity building through availability of training resources.

Existing knowledge and good practices resulting from prior experiences in the implementation of regional collaboration projects will also enhance the cost-effectiveness of ENANDES. An example is the project "Implementing a regional information system to support climate risk management in the Andean region," funded by the Inter-American Development Bank and implemented by CIIFEN before this institution was designated as the RCC-WSA in partnership with NMHSs of Colombia, Ecuador, Peru and Bolivia. Another example of successful regional collaboration focused on community-based early-warning systems was Project PRASDES (www.prasdes-ciifen.org).

The provision of climate services to enhance the capacity of ENANDES nations and communities to adapt to a varying and changing climate can have positive side effects due to the intersection with other societal goals,

called co-benefits. Some adaptation actions may have benefits for climate change mitigation: for instance, the increased use of non-traditional renewable sources of energy resulting from a better knowledge of generation potential will reduce GHG emissions. A specific example is the planned installation by IDEAM of instruments to characterize the potential for photovoltaic generation in rural areas of Colombia. Incidentally, supplying electricity to rural households through small photovoltaic installations may be much more cost-effective and fast than trying to extend the national grid to reach small villages or groups of houses. Conversely, mitigation actions may induce positive co-benefits for adaptation. For example, most of Peru's recently developed NDCs are mostly related to mitigation activities. Nevertheless, many of these activities probably will have co-benefits for adaptation.

ENANDES adaptation actions will yield desirable outcomes such as increased production and incomes for smallholder farmers, better quality of life through provision of solar energy to isolated rural households, and reduced losses from climatic hazards due to preparedness and early warning, to name just a few. In other words, the benefits from enhanced adaptation to climate variability and change offer the opportunity to integrate adaptation priorities with development processes, thus generating multiple economic, social and environmental co-benefits.

9 Consistency of ENANDES with National Plans and Strategies (E)

10 Compliance with National Standards and Environmental and Social Policy of the Adaptation Fund (F)

The above two sections are jointly addressed in a set of tables produced for each country and shown in the Annex-2 Documents (Tables A-1, A-2 and A-3). These tables describe the consistency between planned ENANDES activities and national or sub-national sustainable development strategies, development plans, poverty reduction strategies, national communications, or national adaptation programs of action. At the same time, the tables list the compliance of ENANDES activities with national technical standards such as standards for environmental assessment, building codes, etc. Finally, the tables also discuss compliance with the Environmental and Social Policy of the Adaptation Fund.

The detailed evaluation led to the overall conclusion that *the activities and processes proposed by Project ENANDES are highly consistent with, and supportive of national environmental and climate change legislations, development strategies, poverty reduction strategies, national communications, or national adaptation programs of action.*

The project will comply with the Environmental and Social Policy of the Adaptation Fund. A complete screening of risks was completed (see Section 16) and controls will be put in place to ensure that the project will not exacerbate inequalities, negatively impact marginalized populations, or harm the environment. To finalize the formulation of the project design, a number of consultations were carried out with stakeholders to verify interest and commitment to the project and better define activities and strategies for each project component. Consultations with executing partners at all three counties were carried out at national level, and several of the national partners also were involved in local level consultations (see Section 13 for details on the consultation process).

11 Synergies with efforts funded by other sources (G)

ENANDES will not duplicate the efforts of other initiatives or funding sources. Instead, the project will promote synergies with ongoing and planned initiatives that have some degree of overlap in their scope – yet not in the proposed activities. Table 9 lists projects that are ongoing or will start during ENANDES.

12 Learning and knowledge management strategy (H)

Raise awareness about climate variability and change. A central objective of the ENANDES communication and knowledge management strategy is to raise awareness and understanding of climate risks and adaptation solutions, with a culturally- and gender-sensitive lens. Increasing awareness among communities vulnerable to climate will require well-planned outreach and engagement interventions that consider today's complex and rapidly evolving information environment. An important design consideration will be to avoid an "information producer – information user" approach in which information producers place climate diagnostics and forecasts "on the loading dock" [48] for users to pick up and use. Instead, research suggests that iterative interaction between information producers and users is the most critical factor affecting adoption of climate information [176].

Need for expertise in communication. To support the development and implementation of the ENANDES communication and knowledge management strategy, CIIFEN/RCC-WSA will recruit an expert in scientific journalism or communication. This expert will be expected to ensure the visibility of ENANDES activities among institutions in the ENANDES region. The communications expert will develop strong professional relationships with governmental agencies and international donors who may contribute to the future sustainability of ENANDES. The communication strategy also should plan for outreach to the general public, for example by maintaining an active presence of the project in social networks.

Table 9. Climate-related and adaptation projects (ongoing or planned) in western South America and their potential synergies with ENANDES.

Project	Description	Potential synergies
Enhancing resilience to climate change of the small agriculture in the Chilean region of O'Higgins. Supported by Adaptation Fund. The National Implementing Entity is Chile's International Cooperation Agency (AGCI), the Executing Entity is the Ministry of Agriculture, and the Ministry of Environment is a collaborating entity. The main goal of this project is to increase the resilience to climate variability and change of farming communities in the O´Higgins Region.	Specific objectives are to (i) implement a capacity building and training system to increase the resilience of farm communities vulnerable to climate variability and change; (ii) implement measures and technologies for increasing water resource availability for rural communities in the coastal and inner dry lands of the O´Higgins region; and (iii) to improve an agroclimatic decision-support system that will allow local Minagri professionals and farmers to manage the risks and impacts of climate variability and change.	Topics *common* to both projects include the joint redesign of Mesas Técnicas Agropecuarias. The first Chilean MTA – called "mesa agroclimática participativa"– was implemented in Marchigüe, O'Higgins region, with technical input from Colombian experts. The AF project is seeking to develop an agroclimatic observatory in the O'Higgins region. As O'Higgins is just south of the Valparaíso region (where ENANDES will work), to expand the spatial coverage of the planned observatory would not cause significantly higher costs.
Northwest South America Flash Flood Guidance System. A regional component of the Flash Flood Guidance System (FFGS, public.wmo.int/en/projects/flash-flood-guidance-system-global-coverage-gffg) to provide operational forecasters and disaster management agencies with real-time guidance products related to the threat of flash flooding. Implemented by IDEAM, INAMHI (Ecuador), SENAMHI, the US Natl. Weather Service and the Hydrologic Research Center in San Diego, California. Funding by U.S. Agency for Intl. Development.	It will involve two phases during 2018-2020. Phase 1 will include standard flash flood guidance (FFG) system with a landslide module and ingestion of weather radar data. Phase 2 will include FFG advanced modules - Riverine Routing and Urban Flash Flood Early Warning System for selected River Basins and cities in participating countries. Extensive training would be provided to participating NMHSs to allow forecasters to be able to use its products effectively in daily operations.	Synergies with ENANDES Outcomes 1-4, including strengthening of regional coordination and collaboration. ENANDES will benefit from this program's enhancement of predictions of intense precipitation events and tools to nowcast the occurrence of flash floods.
Climate Resilient Basins: Chinchina, Colombia and Mantaro, Peru. (www.cuencasresilientes-ciifen.org). Implemented by CIIFEN 2015-2019. Key partners include IDEAM, Corpocaldas and Vivo Cuenca in Colombia; in Peru: SENAMHI, Ministry of Environment (MINAM), Regional Governments of Junín and Ayacucho, and the Junín Regional Directorate of Agriculture.	The project seeks to increase resilience and reduce vulnerability to climate change in the basins of Chinchiná (Colombia) and Mantaro (Peru), through the strengthening of knowledge production to inform decision-making for local policies and adaptation strategies.	Synergies with ENANDES are tied to activities in this program for the co-design of local climate risk management and adaptation plans with local authorities, institutions and stakeholders.
Strengthening of national systems and regional monitoring and risk management of drought and floods in a context of climate change and desertification in the Andean countries. Funded by Euroclima+ 2018.	Involves Venezuela, Colombia, Ecuador, Peru, Bolivia, Chile and CIIFEN. The main objective is to strengthen national information systems for the integrated management of droughts in western South America.	The project is complementary to ENANDES Outcomes 1, 3 and 4. As the project title indicates, this project is specifically intended to enhance monitoring and management of droughts and floods. Results from this project (just starting) will inform ENANDES early warning systems in demonstration sites.

		Another source of synergies with ENANDES is the strengthening of regional inter-institutional cooperation mechanisms proposed by this project.
Information, governance and action for the reduction of drought risks in Peru and Bolivia in a context of climate change. Funded by Euroclima+ 2018. Conducted by SENAMHI Peru and SENAMHI Bolivia, Helvetas Swiss Intercooperation and PREDES. Started in January 2019.	This project aims to contribute to the reduction of agricultural losses tied to the occurrence of droughts in the Bolivian Altiplano in a context of climate variability and change. It addresses the strengthening of institutional and community capacities to respond to climate change through enhanced communication, coordination and governance mechanisms to prepare for, and mitigate the impacts of droughts.	There are clear synergies with ENANDES Outcomes 2 and 3, particularly as this project will focus intensively on the development of User Interface Platforms, a highly important pillar of the GFCS architecture. This project will address the needs of smallholder farmers in the Altiplano, a constituency that shares similar characteristics with small farmers in ENANDES demonstration sites.
Diseño e implementación inicial de un sistema de información sobre sequías para el sur de América del Sur. Funded by Euroclima+ 2018.	Involves Argentina, Bolivia, Brazil, Chile, Paraguay and Uruguay. Has a strong focus on droughts, one of the climatic hazards addressed by ENANDES.	Activities similar to those in ENANDES Outcome 3 (albeit in a different region): development of early-warning systems for drought, including monitoring and prediction, and preparedness actions. Other project activities intersect ENANDES Outcome 1, such as the implementation of climate data management systems, the calculation of drought indices and the development of diagnostic and visualization tools.
RELAMPAGO. Funded by the US National Science Foundation. The project targets central Argentina and Eastern Andes, areas that show some of the most intense convective systems in the world.	RELAMPAGO is seeking to understand questions related to the pre-initiation to initiation, initial organization/severe-weather generation and storm development, which are poorly understood.	Possible synergies with ENANDES Outcome 1, particularly regarding the monitoring and prediction of intense precipitation events leading to flash floods and landslides (e.g., in the Rimac Basin near Lima).
Post-Climandes Initiative. This project is now in planning process and will build on the achievements of Project Climandes funded by the Swiss Development Agency.	The project scope is currently under discussion, but will expand Climandes-like activities to Ecuador, Bolivia and northwestern Argentina, in addition to Peru. The current plans aim to focus on Andean highlands in all four target countries.	The exact scope of Post-Climandes activities is yet to be defined, therefore at this time it is difficult to assess possible synergies with ENANDES. Probable synergies will take place with climate data management systems in ENANDES (Outcome 1).

Active presence in relevant political and scientific fora. The project will identify and participate, as relevant and appropriate, in scientific, policy-based and/or any other relevant networks, communities or fora. Additionally, the project will sustain an active coordination – mostly through CIIFEN/RCC-WSA – with the climate, hydrology and agrometeorology scientific communities of the region, institutions in the WMO system, international programs and donors, and other development projects in the region with similar foci (see Table 9). The Executive Board in-person meetings might include a few guests from international, national or local organizations that should be made aware and possibly involved in ENANDES activities.

13 Consultative Process for Project Formulation (I)

An extensive consultation process involving a very broad range of stakeholders was held in multiple locations during different stages of preparation of this proposal: (i) before ENANDES planning started, (ii) during preparation of the project's Concept Note, and (iii) during the final phase of proposal preparation. Additionally, another set of consultations took place during development of the ENANDES Environmental and Social Impact Assessment (ESIA) and the Environment and Social Risk Management Plan (ESRMP). A list of these efforts and a brief description of the results is presented below. Documentation on the multiple consultation Activities can be found in the Annex Documents.

13.1 Consultations Prior to ENANDES Planning

Chile. The DMC organized several workshops during July 2017 to meet various stakeholders from climate-sensitive sectors and institutions and learn about their needs and expectations about climate information and services. The participating institutions included: Ministerio de Agricultura, Dirección General de Aguas, Ministerio de Energía, Unidad de Gestión de Riesgos y Emergencias Energéticas and Ministerio de Medio Ambiente. *All of these institutions have subsequently agreed to partner with the DMC in the implementation of Project ENANDES in Chile.*

Colombia. The Climate Services for Resilient Development (CSRD) Partnership conducted a stakeholders meeting in Bogota in 2015. The white paper on "Options for Climate Services Investments in Colombia" was published in early 2016. The official launch of the National Framework of Climate Services, held on 1-3 November 2017, provided the basis for a National Plan for Implementing Climate Services. Several preparatory meetings with representatives of agriculture, energy, disaster risk reduction and water sectors took place during September-October 2017, before the NFCS launch.

Peru. During 2014-2016 National Fora on Climate Perspectives in Peru, users of climate outlooks and other stakeholders were consulted by SENAMHI about information gaps and priority needs; this effort yielded valuable information from small farmers, representatives of climate-sensitive sectors and authorities from different jurisdictions. As part of its activities performed in the Climandes Project, SENAMHI conducted a mapping of stakeholders from the agriculture sector in the Cusco region (24 July 2017). This exercise identified 44 stakeholders of different kinds who were interested in climate services for agriculture. Also as part of Climandes, SENAMHI organized two Roundtable Dialogs, held in Lima and Puno, on the potential social and economic benefits of climate services. This event focused on the benefits of alerts about freeze occurrence for quinoa growers in Puno.

13.2 Consultations during Concept Note Preparation

During the development of the Concept Note, consultations were conducted in all three ENANDES countries. A brief summary of these consultations is presented below, and additional detail is in the Annex Documents.

13.2.1 Colombia

- *Consultation in Riosucio, Colombia, 10 July 2018.* The meeting was hosted by Asohofrucol, an association of fruit and vegetable growers. The meeting was attended by 30 people who are members of

Asohofrucol and of the Asociación de Caficultores de Riosucio, a coffee-growers group. Participants involved growers of avocadoes, plantains, fruits and coffee, staff from the Municipality and a female Municipal Council member.

- *Consultation in, Popayán, Cauca, 12 July 2018.* The meeting was hosted by the Empresa de Acueducto de Popayán, the public water company that supplied the City of Popayán. The meeting was attended by 40 people who included managers of irrigation channels, staff from the Aqueduct Company, representatives from project "Custodios de Semillas" discussed above, representatives from the indigenous association or "Cabildo" of Puracé, and members from a group of smallholders (Asocampo).
- *Consultation in Tolima, Espinal, Colombia, 13 July 2018.* The meeting was hosted by FEDEARROZ. Attendance was about 16 people (only 2 women) who were members of FEDEARROZ, a group of small rice growers. The national structure of FEDEARROZ has been promoting a program called *Adopción Masiva de Tecnología* (AMTEC), intended in part to decrease the impacts of climate change through enhanced agronomic management of rice.

Some common findings emerge from the three consultations. First, most stakeholders are concerned about the impacts of strong weather events on agricultural production, such as extreme temperatures, intense rains and freezes; these concerns demand information on a daily scale. All stakeholders want to have better knowledge of their local weather and climate, from long-term statistics to understand what is "normal," to monitoring of conditions in near-real time. Stakeholders demand seasonal outlooks (dry or wet conditions tied to El Niño – La Niña events). A common concern is how to adapt to floods and droughts that can become more frequent. Information about possible adaptations to climate variability and change are desired. Adaptation actions such as farm-level water reservoirs are considered but not many have adopted them. Stakeholders with irrigated crops require information about seasonal and longer-term perspectives about the availability of water for irrigation. There is confusion about the alternative sources and accessibility of weather and climate information, including the existence of conflicting information. There is curiosity about the current capabilities and limitations of climate forecasts and interest in learning more about the technology. All stakeholders demand diagnostic and prognostic information with higher spatial resolution; this demand cannot be satisfied in the near term given the sparse observation networks and the state of the art in seasonal forecasting. Finally, all agricultural stakeholders agree on the importance of having information on the likely impacts of weather/climate on their crops production and profitability – that is they demand climate information "translated" into agricultural impacts.

13.2.2 Chile

- *Consultation in Quillota, Valparaíso, 5 July 2018.* The meeting was hosted by several organizations, including (i) farmers' associations from Quillota and Marga-Marga, (ii) the Junta de Vigilancia of the Third Section of the Aconcagua River, (iii) several entities associated to the Ministry of Agriculture, such as Secretaría Regional Ministerial de Agricultura, Servicio Agrícola y Ganadero, Corporación Nacional Forestal, Instituto de Investigaciones Agropecuarias, Instituto de Desarrollo Agropecuario and the Sección de Emergencias y Riesgos Agrícolas. Other hosts included governmental institutions from the water sector such as the Dirección General de Aguas and the Dirección de Obras Hidráulicas. Farmers from the local region attended the meeting; these were mostly growers of fruits (avocadoes) and vegetables.

The stakeholders included both farmers and technical staff from government institutions related to the agricultural sector. As was found in Colombia, there was strong interest on weather-scale events, that is, the forecast of conditions over the next few days. On these scales, stakeholders require frost warnings, sunshine hours (greenhouse producers), heat waves and strong winds. Because the consultation area in central Chile supports a considerable number of irrigated crops, there is interest in knowing snowpack extent and depth, as this will influence the availability of water, as well as water balances. Those who irrigate using groundwater

want monitoring of water table depths, linked not only to availability but also to the cost of pumping water. The overall impression is that, even if the area includes many smallholders, farmers in this are mainly market-oriented, in particular products that are exported. They seem to have a fair degree of technical knowledge and capabilities, which is reflected in their specific demands for indices that would influence fruit production such as the number of accumulated hours with air temperatures both above 25°C and below 7°C. These stakeholders also expressed a strong need to place any diagnostic or forecast information in a historical context (i.e., compare conditions this year to last year, or to the average of the last N years). E-mails and user-friendly, easy to navigate web sites are the preferred media for receiving climate information.

13.2.3 Peru

- *Consultation in the Municipality of Matucana, Province of Huarochirí, Department of Lima, 11 July 2018.* Unlike previously described consultations, this one focused on stakeholders not only from agriculture, but also from the water and disaster management sectors. The meeting was held at the Civic Center of the Municipality of Matucana, and was hosted by two local organizations: the Dirección Zonal Lima, AGRORURAL, Ministerio de Agricultura y Riego and the Gerencia Ambiental, Municipalidad Provincial de Huarochirí-Matucana. The meeting was facilitated by personnel from SENAMHI and CIIFEN. The meeting was also attended by representatives from several governmental institutions that are partners in ENANDES: Ministerio del Ambiente, Ministerio de Agricultura y Riego, Centro Nacional de Estimación, Prevención y Reducción del Riesgo de Desastres, Instituto Nacional de Defensa Civil, and Autoridad Nacional del Agua. The consultation included a total of 98 participants, of which 71.5% were men and 28.5% women. Participants were divided into three working groups, respectively focused on agriculture, water and disaster risks.

Participants in this consultation stated that the main climatic hazards they faced were intense rains and the associated landslides and floods. In higher altitudes, freezes are a major concern. Other identified hazards include droughts, high temperatures and strong winds. The main impacts of these hazards are loss of human lives, loss of crops and agricultural land and soils, bad nutritional state and increased mortality of animals, low milk production, pests and diseases, damages to irrigation channels and road infrastructure. Participants in the agriculture and water groups had little knowledge of SENAMHI's activities and products. Receiving information is difficult for these two groups because they have limited or nil access to the Internet and limited interactions with local government agents such as agricultural extension agents and irrigation technical staff. These two groups requested information about intense rains and freezes, including early warnings about these events. Users from the disaster risks group were more familiar with SENAMHI's activities, but still expressed difficulties in using the information produced by this institution, stating that they found it difficult to understand and that the information had insufficient spatial resolution for disaster-related applications. Overall, these stakeholders perceived a large deficit in disaster preparedness and spoke of the need for a comprehensive disaster management system that included prevention and response.

- *Consultation targeting the energy sector from the Rímac Basin, Lima, 13 July 2018.* The meeting was hosted by SENAMHI and the Ministerio del Ambiente. Stakeholders from the energy sector included (i) ELECTROPERÚ, (ii) the Organismo Supervisor de la Inversión en Energía y Minería (OSINERGMIN), a public institution tasked with regulating and supervising the electricity, oil and mining firms, (iii) the Ministerio de Energía y Minas, and (iv) Auster Energía, a consulting company with expertise in the fields of climatology, environment, water and renewable energy in Peru. The meeting took place at SENAMHI Headquarters in Lima, as all stakeholders involved with energy issues in the Rímac Basin are based in that city.

This consultation was focused on issues related to the energy sector in the Rímac Basin. The consultation identified intense rainfall as the major climatic hazard in the region of interest, because of the associated risks of flooding and landslides, followed by droughts. Impacts include landslides and sediment flows,

sedimentation of riverbeds, and losses associated with damage to infrastructure (gas pipelines, hydraulic infrastructure, hydropower turbines). Strong winds may cause damage to wind turbines. On short time scales of 24 to 72 hours, the energy sector demands of streamflow and winds, as well as hydrological warning systems to issue alerts about floods. On longer scales, stakeholders want scenarios of present and future water availability, information about basins with high hydropower potential, and better characterization of conditions related to wind and solar electricity generation. The stakeholders are aware of information produced by SENAMHI but perceive it as difficult to use despite the technical sophistication of these users and not always timely. A platform more closely aligned with stakeholders' data needs would be welcome.

13.3 Consultations to Inform ESIA and ESRMP Preparation

During final proposal preparation, another round of consultations was held in the three countries to inform the development of the ESIA and ESRMP. The objectives of these consultations were (i) to engage relevant local and national stakeholders to validate and expand - if necessary - the main findings of the desk review of the ESIA and (ii) to integrate into the ESRMP a few context-specific recommendations for risk mitigation and management measures identified by the main stakeholders. The consultations were conducted in the three countries and in accordance with the AF's ESP and related documents. A brief summary of these consultations is presented below, and additional documentation is included in the Annex Documents.

- *Consultations in Santiago, 19 February 2019.* This round of consultations involved meetings with national-level ENANDES partners. Participants were representatives from (i) Ministry of Energy; (ii) Ministry of Environment (MMA); (iii) Ministry of Public Works, General Directorate of Water, Division of Hydrology; (iv) Ministry of Agriculture (MINAGRI), Department of Emergencies and Agricultural Risks Management (SEGRA) and (v) the Chilean Meteorological Directorate (DMC).

This meeting assessed the interest in participation and the expected roles of national-level institutions in ENANDES. MINAGRI recognizes itself as a direct beneficiary of the project, and it also has high influence because they can contribute specific sectorial information that should guide the focalization and design of activities (particularly for Component 3). Thus, MINAGRI is seen as a key strategic partner of ENANDES in Chile. The Ministry of Energy will participate through its Division of Sustainable Energy (DES) and its Department of Energetic Markets (DEM). Just like MINAGRI, the Ministry of Energy is both a beneficiary and a key strategic partner of ENANDES Project in Chile (particularly for Outcomes 1 and 2). The Ministry of Environment is highly interested in the project even though its role is more political than technical regarding climate information and services; this Ministry, however, could be strongly involved in the NFCS process. Ministry of Housing and Urbanism (MINVU) and the National Office of Emergencies (ONEMI) are seen as beneficiaries of the information and the ENANDES Project already has some activities designed based on their needs. Ministry of Health (MINSALUD) was firstly identified during the consultation process as related to the project inasmuch as higher precision on seasonal forecasts may benefit projections of respiratory diseases. Human health, therefore, is another sector that could be involved in the NFCS process at a later date.

13.3.1 Chile

- *Consultations in Quillota, Valparaíso, 20 February 2019.* This round of consultations involved a meeting with local-level ENANDES partners. Participants included representatives from various entities attached to the Ministry of Agriculture such as (i) the Department of Emergencies and Agricultural Risks Management (SEGRA), (ii) the Regional Ministry Secretariat for Valparaíso Region (SEREMI Agriculture), (iii) the Agricultural and Livestock Service (SAG), and (iv) the Institute of Agricultural Development (INDAP). Also present were representatives from the Chilean Institute for Agrarian Research (INIA) and from Chilquinta Energy, a private electrical generation company. Representatives from community-based organizations had initially confirmed their participation, but cancelled at the last minute.

A result of this consultation was the need for active involvement in the project implementation of local entities with direct competencies in sectoral agendas. Thus, in addition to actors from the national level, at least in Chile ENANDES will need to work closely with local stakeholders who have a clear understanding of the local context and knowledge about information needs and gaps. This is particularly true for ENANDES Outcome 3 and the agriculture and water sectors. Not only sectoral stakeholders, but also local governments/decision makers are relevant for the project: municipalities and planning units from regional governments were viewed as key actors and important users of ENANDES information at local scale. Some of the stakeholders, despite having shown both high interest and influence in the national scale dialog, were identified during the local consultation process as not having a strong presence in the territory (e.g., the DGA). This situation is beyond the scope of ENANDES, yet it needs to be considered. Relevant institutional arrangements for climate change management were missing from the initial identification of relevant stakeholders, namely, the Regional Committees on Climate Change – CORECC. Consultation participants stated that community-based organizations such as supervision committees and water canal associations (water user organizations) should have a strong interest in the ENANDES Project. As mentioned above, however, representatives of these organizations cancelled their participation at the last minute. Even though no reasons were offered for the cancellation, comments during the national and local dialogues mentioned existing tensions about land use and water resources in the area; these issues seem to be affecting the relationship between institutional and community local actors.

13.3.2 Colombia

- *Consultations in Bogotá, 12-19 February 2019.* This round of consultations involved six ENANDES national stakeholders and two local implementing partners. Personnel from the following institutions were interviewed: (i) IDEAM's Sub-Directorates involved with the project (Meteorology, Environmental studies, Ecosystems and information, and Hydrology); (ii) Ministry of Mines and Energy - MME; (iii) Ministry of Agriculture and Rural Development - MADR; (iv) Agricultural Rural Planning Unit - UPRA; (v) Ministry of Environment and Sustainable Development - MADS; (vi) National Unit for Disaster Risk Management UNGRD; and the (vii) Río Piedras Foundation and (viii) Ecohabitats Foundation, local implementation partners.

IDEAM´s meteorology sub-directorate will lead the project as a demonstration of the implementation of the NFCS. MME suggested that their participation in the ENANDES project should be led by the sub-directorate of environmental and social studies and the sub-directorate of energy, in order to contribute with the alignment of the project with the sectoral climate change plan and the renewable energy goals in non-interconnected areas. MADR identified itself as a clear beneficiary of the project, as it would strengthen the technical working groups on climate and agriculture in Cauca, and the potential to scale up the experience of involvement of indigenous communities at the above-mentioned working groups. UPRA was identified as an influential stakeholder, especially for Outcome 1, by providing information such as characterization of productivity and planning and zoning of crops at a territorial scale. Likewise, a mutually-beneficial partnership with ENANDES can take place within the framework of the Agricultural Risk Management System (SIGRA). MADS is highly interested and identifies its role as the political actor guaranteeing the project's alignment with the National Development Plan. MADS also perceives ENANDES as emblematic for the community-based adaptation approach. UNGRD recognized itself as highly influential for the project in order to guide the development of drought risk scenarios and articulate results with the National Drought Commission. Likewise, they identify themselves as beneficiaries, as they would use ENANDES information to build, calibrate and validate risk scenarios.

- *Consultations in Popayán, Cauca, 26-27 February 2019.* This round of consultations carried out in the Colombia demonstration adaptation site involved local actors likely to be involved in ENANDES activities. A workshop was held with an attendance of a total of 44 people including representatives from

indigenous populations in Puracé and Quintana, peasant local organizations ASOCAMPO, Asoproquintana, ASFACAPROMA, and Asamcerillos (a rural association of women producers in Los Cerrillos), participants in the project "Custodios de Semillas" funded by the Popayán Aqueduct Company, sub-national government entities, the regional risk management unit and the Popayán Aqueduct Company.

The Río Piedras Foundation is a key local partner with significant credibility in the region, which facilitates interactions with local communities and other subnational stakeholders such as the Regional Autonomous Corporation of Cauca and the local office of risk and disaster management. The Foundation is also in the capacity to act as an institutional bridge among the national and regional scales of implementation. The Foundation Ecohabitats is an NGO working at Cauca which would be highly interested in becoming a potential partner if the demonstration area is extended to other sub-basins. Since the consultations, ENANDES has decided to expand activities to the Los Cerrillos region and formally invited Ecohabitats to join the project. Community actors viewed themselves as both beneficiaries and participants of the process; moreover, they perceive that ENANDES is closely aligned with their local adaptation planning initiatives. Thus, they are highly motivated and interested in engaging with the project. Some national stakeholders that expressed interest and have high influence were identified in the local consultation process as not having a very strong presence/articulation with the local communities (for example, MADR and MME). This is a situation that needs to be considered, as it could influence the sectoral component of the project implementation.

13.3.3 Peru

- *Consultations in Lima, 23-29 January 2019.* This round of consultations involved meetings with SENAMHI staff and representatives from the national level partners in ENANDES. The first meeting was with representatives of the Ministry of Agriculture (MINAGRI), the Ministry of Energy and Mines (MINEM), and the National Water Authority (ANA). The second meeting was with representatives of the National Civil Defense Institute (INDECI) and the National Center of Disaster Risk Estimation, Prevention and Reduction (CENEPRED). The third meeting was with representatives of the Ministry of Environment (MINAM). The main goal of these meetings was to define the activities to be included in the final ENANDES proposal.
- *Consultations in Matucana, Province of Huarochirí, Department of Lima, 18 February 2019.* These consultations included meetings between project representatives and local stakeholders in the Rímac Basin. Meetings with three actors were finally held. The first meeting was held at the Municipality of Huarochirí with representatives of the following units: (i) disaster risk management, (ii) agriculture and (iii) environment. Then, the head of the Agrarian Office of Matucana was interviewed. This Agrarian Office reports to the Regional Government of Lima. The next interview was conducted with the head of the Agrarian Agency of Santa Eulalia, which also reports to the Regional Government of Lima. So far, the actor who could not be interviewed was AGRORURAL in Santa Eulalia.

For local activities related to disaster risk management a key actor identified in the implementation of adaptation actions is the local government at the district level. In addition, the implementation of Early Warning Systems is important in order to articulate the information provided by SENAMHI with the diffusion activities of INDECI for the prevention of major disasters due to floods and landslides. For activities related to the agriculture sector, the chain of relevant climate information produced by SENAMHI would involve MINAGRI as the main recipient at the national level. In turn, information would be distributed to regional and local level through agencies and agricultural offices, which would be prioritizing the adaptation measures of the sector and also the annual sowing of crops. AGRO RURAL is the *Programa de Desarrollo Productivo Agrario Rural* (www.agrorural.gob.pe), an entity attached to the Ministry of Agriculture that promotes rural development through public investment programs.

13.4 Consultations during Final Proposal Preparation by SENAMHI

- *Consultations in Lima, 8 February 2019.* This consultation was held at SENAMHI Headquarters in Lima and was attended by representatives from the ministries of Environment, Agriculture, ANA, CENEPRED and INDECI. The central purpose of this consultation was to ensure the alignment of ENANDES goals and activities with the recently presented document with 91 specific NDCs developed by MINAM. There was consensus that ENANDES plans were closely aligned with the NDCs, particularly the adaptation actions that each sector has committed to implement. This was a particularly important conclusion because MINAM is the focal point for the Adaptation Fund and will have to endorse this proposal.

MINAGRI suggested that the National Institute of Agrarian Innovation (INIA) could also be an important recipient of climatic services and climate information produced by SENAMHI as part of the ENANDES project. This information would be useful in order to investigate and propose various technological packages within the framework of the measures of adaptation proposed by the agriculture sector. The National Service of Natural Areas Protected by the State (SERNANP) is the agency attached to the MINAM in charge of the technical and administrative criteria for conservation of Protected Natural Areas (ANP) and for preservation of biological diversity. SERNANP carries out its work in coordination with regional governments and local owners of properties recognized as private conservation areas. Because both ENANDES intervention areas in Peru – the Rímac and Huallaga basins – include ANPs, SERNANP should be involved in the monitoring of impacts on ANPs in those areas (e.g., the Bosque de Zarate Reserved Zone in the Rímac Basin and the Cordillera Azul National Park in the Huallaga Basin). The National Service of Environmental Certification for Sustainable Investments (SENACE) is attached to the Ministry of the Environment and tasked to review and approve the Environmental Impact Studies of public, private or mixed capital investment projects. Within the framework of ENANDES project, it is important to consider SENACE in order to monitor the impacts that could be produced by the activities directed to the energy sector. For activities related to the energy sector, the chain of relevant climate information produced by SENAMHI would have as a recipient the MINEM at the national level. The MINEM, in turn, would articulate with the main beneficiaries of such information, private investors, who would execute investment projects, and the general population that will be able to satisfy their energy needs.

- *Consultations in Tarapoto, San Martín, 15 March 2019.* These consultations included meetings between SENAMHI representatives and local stakeholders in the Huallaga Basin. The meeting involved authorities, technical specialists, irrigation users, NGOs and academia. The goal of the meeting was to assess the needs for climate information to be generated by ENANDES to support demonstration adaptation activities in this demonstration area. The meeting involved 70 participants (25% women).

The meeting confirmed the earlier identification of droughts and floods as the main hazards of concern. Data required include temperature, precipitation, and streamflow. There is a need to strengthen hydrometeorological observation networks, and to integrate data from other networks in the region. A breakout group on agriculture identified the main crops in the region: coffee, cacao, rice and maize. Agricultural stakeholders requested monitoring of recent and current conditions and forecasts of weather and climate variables, agroclimatic information and streamflow predictions. Other information desired included agroclimatic zoning and training on EWSs. A breakout group on management brought up existing experience on the topic of payment for ecosystem services as a way to ensure adequate supply of water of good quality. However, there is much less knowledge of climate issues among local authorities and resource managers. There is a perception that extreme climate events and climate change complicate consideration of climate in plans and programs. Planning for disaster risk management and preparation for floods and prevention of erosion is the responsibility of the regional government, the Centro de Operaciones de Emergencia Regional (COER) and Civil Defense. These entities require knowledge about the frequency of occurrence of thresholds for precipitation and streamflow that trigger contingency plans.

14 Budget Justification and Discussion (J)

Table 10. Justification for funding requested.

Expected Outcomes	Baseline (current status)	Impact due to the proposed programme with support from Adaptation Fund (AF)
Expected Outcome 1: Enhanced design, production and communication of climate/water information and services.	ENANDES NMHSs have climate data management systems of different kinds and with different capabilities (ranging from a collection of Excel files to commercial relational data bases). Large variability in formats of available hydrological records. Many climate records only available in paper support and deteriorating rapidly. Some quality control protocols exist for observations from conventional stations (operated by human observers). No protocols available for data from automatic weather stations. Incomplete metadata for weather stations is common. Some procedures for seasonal forecast (mostly statistical) available; no regional experience on sub-seasonal forecasts. Separate tools to access/analyze climate change projections in each NMHS.	Common needs and gaps for climate data management systems will be identified and addressed collaboratively. Hydrological data will be considered explicitly. A certain amount (depending on cost) of historical climate/water records on paper will be scanned, digitized and made accessible in digital formats. Quality control protocols will be developed and implemented for data from automatic weather stations. Weather station metadata will be completed and made available through OSCAR/Surface metadata system. National observation strategies and WIGOS plans will be developed for the future evolution of the observing systems, based on the recommendations from the assessments of national observing networks. Implementation of a seamless sub-seasonal to seasonal forecasting system in collaboration with external partners. Enhanced tools to access/analyze climate change projections implemented jointly through collaboration among NMHS.
Expected Outcome 2: Strengthened institutional coordination and value-adding tools and processes allow climate/weather information to be tailored and translated into user-centric and sector-specific adaptation actions.	ENANDES NMHSs lack expertise in the translation, transfer, and facilitation of the use of climate information. NMHSs lack effective engagement mechanisms with climate information intermediaries and end users, thus hindering the sector-specific tailoring of climate information. A fundamental misfit exists between the scientific capabilities of climate information producers and the expectations, needs and beliefs of potential users. Mechanisms for routine feedback from users about the design and content of climate information are unavailable. Few process models (statistical or mechanistic) are calibrated and validates so that observed and expected climate conditions can be “translated” into likely sectoral outcomes (crop yields, availability of irrigation water, hydropower generation capacity). Climate information products are implemented based on what producers “think” that users will need or like.	Strong engagement with institutions from climate-sensitive sectors will help to translate climate observations and forecasts into likely sectoral impacts. Strategic partnerships with institutions and actors from climate-sensitive sectors will allow sector-specific tailoring or “customization” of climate information to specific needs and decision protocols. Sustained interaction between producers and users of information in the framework of ENANDES activities will enhance the fit between information and needs. ENANDES products will include mechanisms to receive feedback from users. Calibrated and validated models to translate expected climate conditions into likely sectoral outcomes. A user-centric perspective of climate service products and processes is based on an understanding of users’ needs and the state of the art in climate science (i.e., some need cannot be fulfilled at present). ENANDES will undertake activities that are prerequisites for the development of the NFCS, providing tangible real-world experience and lessons that will facilitate NFCS implementation.

Expected Outcomes	Baseline (current status)	Impact due to the proposed programme with support from Adaptation Fund (AF)
	The planning process for implementation of National Frameworks for Climate Services (a goal desired by in each ENANDES country) has limited funding, thus slowing down the process.	
Expected Outcome 3: Engaged and empowered stakeholders have participated in the co-development and implementation of local plans and activities for adaptation to climate variability and change that rely on climate/water information.	Only few local studies address the social, economic, and cultural root causes of climate risks and vulnerabilities that limit the design of local climate adaption activities. Despite the potential benefits from existing climate information, its uptake by decision makers so far has been limited. Operational commitments limit the capacity of NMHSs to develop outreach and communication contents to sensitize local communities to climate variability and change. Without financial support, it is impossible to co-design, implement and assess local adaptation activities. Few early-warning systems are active in the region.	Vulnerability assessments will be performed in every ENANDES demonstration adaptation site. ENANDES will design and implement multiple activities to enhance the capacity and willingness of different stakeholders to access, understand and use climate information for management of, and adaptation to weather/climate hazards. ENANDES will design and implement outreach and communication efforts to sensitize local communities to climate variability and change and their local/sectoral impacts. Insights from recent work on communicating climate change will improve outreach. AF support to NMHSs and executing partners will allow the co-design, implementation and assessment of local adaptation activities. Early-warning systems will strengthen management of the risks and impacts of extreme weather/climate hazards such as droughts and floods.
Expected Outcome 4: Regional and global coordination and cooperation mechanisms have been strengthened; lessons, tools and approaches from ENANDES help others to provide climate services and replicate adaptation actions elsewhere.	No coordination for the assessment of the socio-economic benefits of climate services and adaptation actions. Few volunteer observing networks exist that provide weather and water observations to complement official observation networks. In recent years, the activities and interactions of Regional Technical Working Groups (including experts from non-ENANDES countries) have been inactive due to lack of support for meetings and joint activities. Information technology and climate experts in each NMHSs currently develop in-house tools and procedures without coordination; many efforts are triplicated (i.e., each ENANDES country has a version of a tool). Operational provision of climate services requires new skill sets, including competencies from multiple disciplines and fields.	With AF funding, CIIFEN/RCC-WSA will convene workshop to review state-of-the-art approaches for the estimation of socio-economic benefits (SEBs) from demonstration adaptation interventions. The workshop will allow participants from ENANDES countries to reach consensus on methods to be used for SEB estimation. CIIFEN/RCC-WSA will provide technical advice and guidance for the implementation of volunteer weather and water observer systems. AF support will initiate or invigorate the activities of Regional Technical Working Groups (TWGs), such as those for data base developers, S2S prediction and Andean hydrology. All tools and procedures jointly developed by ENANDES experts will be collated into a “Climate Services Toolkit” (CST). The joint development of analytical tools will not only raise the capacity of all NMHSs by sharing learning and drawing on each other’s strengths, but also will significantly improve the economic efficiency of ENANDES, as development costs will be shared and duplicated efforts avoided. AF funds will support a suite of training activities undertaken jointly by the ENANDES countries, the WMO’s Training Activities Division and the existing WMO Iberoamerican Regional Training Centers.

15 Sustainability of ENANDES Outcomes (K)

The participating NMHSs are operational entities within their national governments. The sustainability of project activities will be strengthened by the roles of DMC, IDEAM and SENAMHI as government agencies supported by public funding with officially mandated duties. More importantly, many ENANDES implementation partners are other governmental institutions from the three countries. The partnerships between an NMHS and another government agency to collaborate in developing/enhancing a function that is within the other agency's mandate will enhance significantly the chances that these activities will continue after ENANDES funding ends. For example, if the Chilean DMC provides information and services deemed as relevant, useful and actionable by the country's National Electricity Coordinator (NEC, the office that allocates dispatch from power generation units across Chile), the NEC will likely expect that information to continue to be provided after the end of ENANDES, and probably will help the DMC to secure the necessary funding. This example of partnerships as a key for future sustainability applies across most ENANDES activities. Similar partnerships include (i) the Ministries of Agriculture to carry out Mesas Técnicas Agroclimáticas in the three countries, (ii) collaboration with the Ministry of Mines and Energy to jointly explore solar energy as a more efficient alternative than connecting isolated rural populations to the national grid.

Outcome 1 will foster a major strengthening of operational capacities and tools available to participating NMHSs. This will be accompanied by a comprehensive capacity building strategy to be carried out with the participation of WMO's Training Activities Division and Regional Training Centers in Peru, Argentina and Brazil, and the CIIFEN/RCC-WSA. The training component will produce and update relevant training material and e-learning tools which will help train many other NMHSs staff members, even after the end of ENANDES funding. Most importantly, personnel from ENANDES NMHSs will receive training on the state of the art in providing climate services, including issues on which all Services in the region have limited expertise, such as the translation, transfer, and facilitation of the use of climate information and, particularly, the development of effective engagement mechanisms with information intermediaries and end users. These competencies will benefit climate service provision long after the end of ENANDES. All the analysis and visualization tools to be developed by ENANDES will rely on free and open source software, thereby reducing the risks of discontinuity in operational tools due to lack of funding to purchase/renew software licenses. The sustainability of the meteorological observing networks is a major goal of WIGOS. The engagement of the NMHSs with the operational activities of the Regional WIGOS Centers (RWCs) will contribute significantly to improve and maintain the performance of national observing stations at the required levels.

Outcome 2 has been designed to help build a broad knowledge and action network of institutions and other stakeholders to support the climate services information chain. The development of this network will help to sustain the flow of usable climate information provision in a continuous way. Moreover, this component will push forward the creation of National Frameworks for Climate Services – a goal already stated by all ENANDES countries. The sustainability of the climate services will be based on the perceived social and economic benefits of the new information services to trigger further support from public institutions, local governments, private firms and the community in general.

Outcome 3 aims to implement adaptation activities at local level. Through a participatory process of dialogue and discussion, the project will promote project buy-in and ownership by local authorities, communities and private stakeholders. There is prior experience in ENANDES demonstration sites that suggests that if an intervention is perceived as beneficial by stakeholders, it generates community and political support and sustained funding. Some of these prior examples include the seed conservation programs and the voluntary observation networks in Popayán, Colombia.

Outcome 4 aims in part to foster the sustainability of activities in Outputs 1-3. From a technical point of view, the capacity building activities and the strengthening of regional Technical Working Groups will ensure the

long-lasting availability of highly-trained personnel in the region's NMHSs. The proposed "tripletting" or shared activities and mutual learning among technical personnel will guarantee a common knowledge base about the tools, approaches and processes implemented during ENANDES that will be available long after the project's end. From the financial perspective, as part of this outcome the CIIFEN/RCC-WSA is tasked to sustain dialog and coordination with other projects taking place in the area and having similar scopes, and to liaise with a range of institutions, from all the regional and global entities in the WMO orbit, to international donors. As the dialog will be initiated soon after project inception, communication of successful achievements throughout the project will enhance the chances of future support.

16 Overview of Environmental and Social Impacts and Risks (L)

The process for identifying overarching risks and measures for the ENANDES project is summarized here and details are provided in the Annex Documents. The following four main stages were part of this process: (1) identification of relevant AF principles for the context of the ENANDES project; (2) screening and preliminary identification of potential risks at the desk phase; (3) validation and identification of new risks, opportunities and measures during the consultation process; and (4) analysis of the risks and measures identified during steps 2 and 3.

The 15 core AF Principles are an important checklist to ensure that projects to be carried out respect laws, people's rights, gender equity, heritage, and biodiversity and the environment. This project targets many of the AF's core principles by design, and actually focuses on climate change adaptation and disaster risk reduction while simultaneously aiming to enhance the livelihoods of vulnerable peasant and indigenous communities, thus providing incentives to retain the youth in the territory, and to empower women to make better informed decisions about food production, water and energy. The results of the screening of applicable AF Principles are summarized in Table 11.

Table 11. Summary of results from the screening process. Grey boxes indicate AF Principles that were not applicable, did not continue to the assessment stage, or were found to be not outstanding during the assessment and consultation. Arrows indicate Principles that move on to the following stage of the screening.

	Adaptation Fund Principle	Does it apply to the project?	Does it continue to the assessment stage?	Was it outstanding at the consultation process?
1	Compliance with the Law	Yes →	Yes →	Yes
2	Access and Equity	Yes →	Yes →	Yes
3	Marginalized and Vulnerable Groups	Yes →	Yes →	Yes
4	Human Rights	Yes →	NO	—
5	Gender Equity and Women's Empowerment	Yes →	Yes →	Yes
6	Core Labor Rights	Yes →	NO	—
7	Indigenous Peoples	Yes →	Yes →	Yes
8	Involuntary Resettlement	NO	—	—
9	Protection of Natural Habitats	Yes →	Yes →	NO
10	Conservation of Biological Diversity	Yes →	Yes →	NO
11	Climate Change	Yes →	Yes →	NO
12	Pollution Prevention and Resource Efficiency	NO	NO	—
13	Public Health	Yes →	NO	—
14	Physical and Cultural Heritage	NO	NO	—
15	Lands and Soil Conservation	Yes →	Yes →	NO

As a result of the screening process, three of the AF principles were found to be not applicable to ENANDES given the proposed project activities and required no further assessment. Of the remaining 12 applicable principles, nine continued to the assessment stage. After assessment during both desk study and consultations, no significant risks or necessary management actions were identified for four principles. Finally, five principles were found outstanding during the consultation process: 1) Compliance with Law, 2) Access and Equity, 3) Marginalized and Vulnerable Communities, 4) Gender Equity and Women Empowerment, and 5) Indigenous peoples.

Risks and measures resulting from stages 2 and 3 outlined above were analyzed and integrated as the final six overarching social and environmental risks and nine measures of the Environment and Social Risk Management for the ENANDES project. In order to rate the magnitude of each risk, the procedure developed by UNDP in its Social and Environmental Safeguards was followed. Most of the identified overarching risks were rated as moderate (yellow cells in Table 12), and each of them has different levels of impact (I) and probability of occurrence (P). Likewise, these overarching risks can be classified as direct or indirect. For direct risks, there is enough evidence to note that the potential risks are attributable to the scope of the project, thus it is more viable to identify a causal relationship. So, it is possible to classify the risks considering the criteria of probability of occurrence and the level of impact (see Table 12). A series of factors may come together to generate risks identified as indirect, making it less feasible to attribute the impacts to the project through a direct causal relation. For this reason, the indirect risks are not rated. Nevertheless, both for direct and indirect risks mitigation measures have been identified and suggested.

Table 12. Overarching risks identified for Project ENANDES. Risk levels are rated by impact (I) and probability of occurrence (P) on a scale of 1 ("negligible") to 5 ("critical"), where 3 is "moderate" and 4 is "severe". Color code (column "S") follows the UNDP's Social and Environmental Safeguards convention: Green = Low, Yellow = Moderate, Red = High. "Dir" and "Ind" indicate "direct" and "indirect" risks, respectively.

		Risk Level				
	Overarching risks (applicable to all countries)	I	P	S	Dir/Ind	Related AF Principle
1	Weak inter-institutional coordination and articulation for the project design and implementation (both amongst national institutions and between national and sub-national levels) causing weak alignment of ENANDES with regulatory frameworks in Peru, Chile and Colombia.	3	4		Dir	Compliance with law
2	Low availability and access to climate services developed in the framework of the ENANDES project due to: 1. Availability; i) insufficient mechanisms to exchange quality information among regional, national and subnational levels. 2. Access; i) lack of context-specific communication channels to facilitate close interactions between scales, ii) unclear information /inability to bridge the gap between information developed by scientists and the practical needs of end-users.	3	4		Dir	Access & equity
3	Insufficient participation of key stakeholders due to i) mistrust between national and subnational actors, ii) lack of participatory platforms / mechanisms, and iii) gaps in existing mappings of key stakeholders and beneficiaries.	3	3		Dir	Access & equity / Marginalized & vulnerable groups
4	Lack of a clear gender perspective in ENANDES as a result of this perspective not being explicitly included in the results framework in terms of associated targets, indicators or baselines.	3	5		Dir	Gender and women empowerment

5	Indigenous and peasant beneficiary families not adequately informed and engaged in order to access the full range of the project's benefits.	1	3		Dir	Indigenous peoples
6	Unexpected uses of information produced in the context of ENANDES could eventually result in new or increased socio-environmental conflicts	Indirect risk Not rated				Access & equity / Marginalized & vulnerable groups

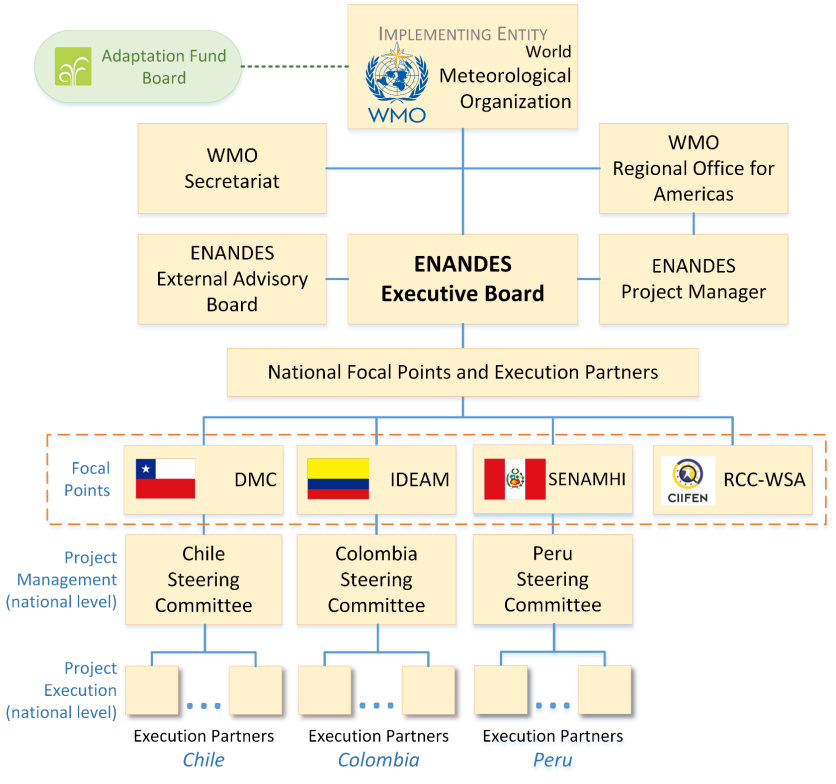
Overall Risk Classification of the Project. The Environmental and Social Risk Management Plan sought to ensure that all risks were identified and managed, and that measures were implemented with an emphasis on risk avoidance. According to the risk screening and assessment process (Table 11), project risks were classified as medium; therefore, according to the AF´s ESP, the ENANDES project would fall into Category B. *Nevertheless, as proposed measures to mitigate social and environmental risks (Table 15) have been incorporated into the proposal (in the applicable sections on results framework, activities, and implementation arrangements), ENANDES can be categorized as a low risk (Category C) project.*

PART III: IMPLEMENTATION ARRANGEMENTS

17 Arrangements for Management of Project ENANDES (A)

Project ENANDES will be implemented by the WMO in partnership with the NHMSs of Chile, Colombia and Peru, the main national authorities responsible for providing weather and climate warnings, advisories and services: the Dirección Meteorológica de Chile (DMC, Chile), the Instituto de Hidrología, Meteorología y Estudios Ambientales (IDEAM, Colombia) and the Servicio Nacional de Meteorología e Hidrología (SENAMHI, Peru). A fourth major partner will be CIIFEN, an international center based in Ecuador for the study of the ENSO phenomenon. Since 2015, CIIFEN was designated as the WMO Regional Climate Center for Western South America RCC-WSA), thus formalizing its interactions with NMHSs from Western South American countries. The proposed governance scheme for ENANDES is illustrated in Figure 19. Some of the main components of the proposed governance are discussed below.

Figure 19. Governance scheme proposed for Project ENANDES.



17.1 Roles and Responsibilities of Project Management Structures

Project Manager. The WMO – the implementing entity – will appoint a *Project Manager* (PM) based in WMO's Regional Office for the Americas in Asunción, Paraguay. The PM will have overall responsibility for coordination and oversight of all proposed tasks, monitoring progress to ensure that tasks proceed and are completed on time. To this effect, s/he will maintain regular contact and communication with the focal points and national project steering committees in Chile, Colombia, Peru and the CIIFEN/RCC-WSA. The PM will prepare regular progress reports for the Adaptation Fund. The Manager will organize meetings of the ENANDES Executive Board and External Advisory Board, preparing background documents and summarizing discussions and recommendations issued by the two Boards. The Manager will coordinate the submission of financial reports with a technical coordinator (25% dedication) at the WMO Secretariat in Geneva.

Executive Board. The main governing body of the project will be the ENANDES Executive Board (EEB). The EEB will serve as the decision-making body of the ENANDES Project and will oversee all ENANDES activities funded by the Adaptation Fund. The EEB will meet physically at least once per year to discharge its responsibilities; more frequent virtual meetings will be organized as necessary. The EEB's roles and responsibilities include but are not limited to: (i) reviewing, discussing and providing substantive comments and recommendations to annual progress reports prepared and presented by the Project Manager during the annual EEB meetings; (ii) ensuring that the strategic operation of ENANDES is consistent with the purpose and objectives stated in the Project Document; (iii) reviewing, discussing and approving the annual work plans, procurement plans and budget submitted by the Project Manager; (iv) defining strategic directions and providing overall policy guidance, recommendations and guidance for project implementation and coordination; (v) Ensure conformity of the project activities with policy and regulations in each country; (vi) provide strategic guidance to ensure the sustainability of ENANDES results beyond the project implementation period; and (vii) ensure that ENANDES maintain gender and age perspectives as much as possible. The Executive Board will include the Permanent Representatives to the WMO in Chile, Colombia and Peru (the Directors of NMHSs), as well as designated alternates. The Board also will include representatives from several parts of WMO, the Implementing Entity: the Director of the Climate Prediction and Adaptation (CLPA) Branch, the Director of the Global Framework for Climate Services (GFCS) and the Director of the Regional Office for the Americas (ROA). The Adaptation Fund focal points in the ENANDES countries will be invited to join the EEB. The Chair of the ENANDES External Advisory Board (see below) will be part of the EEB *ex officio.* Finally, other members of the EEB will include the Director of the CIIFEN/RCC-WSA and the President of WMO Regional Association III (South America).

Advisory Board. The ENANDES External Advisory Board (EEAB) will support the work of the EEB by providing independent strategic thinking and state of the art scientific developments to guide the design and implementation of ENANDES activities. The EEAB will meet in person at least once per year, and virtual meetings will be organized as necessary. The EEAB (6-10 members) will include professionals with outstanding expertise on climate monitoring and prediction, climate services, the targeted sectors of agriculture, water and energy, the social sciences and, generally, the various dimensions of adaptation to climate variability and change. Further, EEAB members should have a track record in strategic thinking and planning in committees and similar fora, and collectively represent a comprehensive and forward-looking view of climate services and adaptation-related issues at national, regional and global levels. A diverse composition of the EEAB should ensure that the Board can provide multiple perspectives. For example, experts from WMO Region III will contribute the perspectives of other countries in the region. A representative of the other RCC in South America (the CIIFEN/RCC-SSA) should provide coordination and alignment processes with other climate service efforts in the region. Representatives from agencies or groups outside South America such as WMO, NOAA in the US, Copernicus in Europe, NMHSs and academic institutions elsewhere should bring global cross-cutting technical expertise and frontier knowledge on

provision of climate services and adaptation to climate variability and change. Finally, the EEAB may include membership from civil society (NGOs or private sector) in the ENANDES region.

National-level governance. Within each ENANDES country, the focal points will be the NMHSs of each country (DMC, IDEAM and SENAMHI, Figure 19). The WMO will give each country the possibility to define its own national governance mechanisms and institutional arrangements. Nevertheless, it is likely that each country will assemble an ENANDES National Steering Committee (ENSC), tasked with assessing the status of project implementation at the national level and provide guidance and recommendations to all national activities. Membership in National Steering Committees should reflect the broad spectrum of partners in national ENANDES activities. The countries are considering the recruitment of local coordinators to manage all adaptation activities in a demonstration area (including outreach efforts, organizing meetings and interactions with stakeholders, field schools, etc.). The National Steering Committees will serve as the starting point in a grievance mechanism.

17.2 Participating Institutions

Table 13. Institutions committed to participating in the ENANDES Project. Note that several partners in the demonstration sites are not yet listed, as formal participation agreements have not been finalized.

Chile	**Colombia**	**Peru**
National Executing Institution: Dirección de Meteorología de Chile (DMC)	*National Executing Institution:* Instituto de Hidrología, Meteorología y Estudios Ambientales (IDEAM)	*National Executing Institution:* Servicio Nacional de Meteorología e Hidrología (SENAMHI)
At national level: Ministerio de Agricultura Ministerio de Energía Ministerio del Ambiente Dirección General de Aguas Coordinador Nacional Eléctrico *At local level:* Secretaria Regional Ministerial de Agricultura (SEREMI), Región de Valparaíso Juntas de Vigilancia, Río Aconcagua	*At national level:* Ministerio de Agricultura y Desarrollo Rural Ministerio de Minas y Energía Ministerio de Ambiente y Desarrollo Sostenible Unidad de Planificación Rural Agropecuaria Unidad de Planeación Minero Energética Fondo para el Financiamiento del Sector Agropecuario *At local level:* Fundación Ecohabitats Fundación Río Piedras Associations of campesinos “Cabildos” of indigenous communities	*At national level:* Autoridad Nacional del Agua Ministerio del Ambiente Ministerio de Agricultura y Riego Ministerio de Energía y Minas Ministerio de Salud Ministerio de Transportes y Comunicaciones Instituto Nacional de Defensa Civil Centro Nacional de Estimación, Prevención y Reducción del Riesgo de Desastres *At regional and local levels:* Regional and local governments

18 Financial and Project Risk Management (B)

Risk, as defined in the WMO Risk Management Policy, is a threat or uncertainty associated with an event that may have a negative effect on the achievement of the results defined in the Strategic Plans of the Organization. Issues on the other hand are a manifestation of unmanaged risks. Improving risk management will reduce the number of issues that arise. Financial and project risk management measures will be assessed throughout the project by WMO – the implementing agency – and executing focal points partners. Potential risks and response measures are described in Table 14.

Table 14. Potential risks related to project implementation and response measures

Risk Description	Type	Risk Rating	Countermeasures / Management Response
Devaluation of currency in ENANDES countries	Financial	Low	Funds will be kept in bank accounts denominated in US dollars until disbursements are required. Whenever possible, the project will specify transactions in US dollars to avoid currency fluctuations. When transactions in local currencies are needed, financial measures will be taken to monitor timely expenditures.
Change of government or key officials in ENANDES countries that negatively affect the project	Political	Low	Any change in governments or mandates will be assessed by the ENANDES Executive Board. The Program Manager and National Coordinators will liaise with any new government officials to explain the project and anticipated outcomes. Most ENANDES partners are from technical levels of government institutions that do not change with administrations. As shown in this proposal, ENANDES objectives and outcomes are fully aligned with national climate change policies, laws and regulations, thus preventing a major change in policy direction. The risk is also minimized through project coordination among technical level stakeholders at national institutions (e.g., Ministries).
Tensions between government and community institutions that – even if unrelated to project - affect implementation	Institutional	Low to Medium	ENANDES Executing Partners and National Steering Committees will sustain dialog with any parties in conflict and clarify the non-involvement of ENANDES in matters unrelated to the project. An example of this risk is the lack of attendance of community entities to consultations in Chile, due to conflicts with government agencies about land and water.
Acceptance of the project slows down project inception.	Operational	Low to Medium	ENANDES Executing Partners and Demonstration Area Coordinators (if appointed) will maintain dialog with groups/communities to ensure their engagement, address any concerns and deflate potential conflict.
Communities in demonstration adaptation areas lose interest in the project.	Operational	Low to Medium	Baseline analysis of current needs and expectations for climate information will ensure that the project's products respond to stated needs. Continuous dialog will help to manage expectations from stakeholder that cannot be satisfied given the current state of the art (e.g., climate forecasts with small spatial resolution). Absolute transparency about capabilities and limitations of disseminated climate services will be a fundamental project policy, This risk will be mitigated by integrating participatory approaches at all stages of the project. Community based monitoring and perception studies will be carried out.
Tension between ethnic communities or with peasant organizations affects project implementation.	Political	Medium to Low	During proposal preparation, the existence of active conflicts among different stakeholders (e.g., campesinos vs. indigenous populations) was assessed and found to be small throughout the demonstration adaptation areas selected. During implementation, the project will continuously liaise with representatives of different actors (e.g., smallholder farmers' associations, indigenous "Cabildos" in Colombia).
Lack of coordination between participating local, regional, and national entities.	Operational	Medium	Roles and responsibilities of different institutions/actors will be clearly defined during at the project inception workshop and during any in-person or virtual meetings. National coordinators will periodically monitor the existence of any potential conflicts. Participating institutions and actors from different institutions and jurisdictions will be integrated into National Steering Committees to facilitate and streamline dialog.

Delays of contract approvals and release of funds to implementation partners.	Operational	Low to Medium	Advance preparation and planning of contracts and terms.

19 Environmental and Social Risk Management (C)

Environmental and social impacts and risks have been identified for the proposed project (see Section 16). An Environment and Social Risk Management Plan (ESRMP) has been prepared and its full version is included in the Annex Documents. Table 15 summarizes the risks/negative impacts identified during the ESRMP process, and suggested measures to mitigate said risks, together with some additional indicators to monitor progress in addressing the risks. Mitigation measure measures have been provided only to principles where potential impacts and/or risks have been identified.

Table 15. Risks identified during the Environmental and Social Risk Management Plan process.

Potential risk	Mitigation measure(s) to enhance the project benefits	Monitoring indicator(s)	Responsible actor(s)
Weak institutional coordination and articulation for project design and implementation (both among national institutions and between national and local levels) causing weak alignment of the ENANDES project with national regulatory frameworks in Peru, Chile and Colombia	Formalization of the project governance including: (i) Identification of regional, national, subnational and local strategic partners and their roles in project; (ii) establishment of participatory and decision-making instances; (iii) identification of coordination mechanisms with existing processes related to climate change management; and (iv) identification and formalization of working agreements in order to ensure sustained and articulated participation.	An Inception Report prepared after the Inception Workshop that explicitly lists roles and responsibilities, as well as an organizational chart and the terms of reference for different project instances and roles.	Implementing Entity National Executing Entities Project Manager Executive Board
Low availability, access and use of climate services developed in the framework of the ENANDES project due to: 1. Availability. Insufficient mechanisms to exchange quality information among regional, national and subnational levels. 2. Access. Lack of context-specific communication channels to facilitate close interactions between scales. 3. End-users are unwilling to uptake information	Establish, socialize and agree with relevant stakeholders of the project at the regional, national, subnational and local level, clear protocols for information exchange, including, when necessary, the identification of existing gaps and measures to overcome them (e.g. confidentiality agreements)	A document detailing the protocols and agreements for use and management of the information generated by ENANDES. The document should contribute to the identification of gaps and good practices for exchanging information as part of ENANDES project, considering context-specific conditions for each of the three countries.	Project Manager National Project coordinators National Executing entity
	Conduct a characterization of context-specific communication channels to define which means of communication are more frequently and effectively used by community stakeholders in the specific intervention area. This document should serve as an input for the communication strategy of the project.	A document with the characterization of context specific communication channels for each of the three countries.	

and services developed by ENANDES.	Identify possible barriers or impediments (technical, financial, cultural) that limit uptake of climate services.	A document exploring identified barriers or impediments to use of climate information and services.	
Insufficient participation of key stakeholders due to (i) mistrust between national and local actors, (ii) lack of participatory platforms / mechanisms, and (iii) gaps in existing maps of key stakeholders and beneficiaries.	Exhaustive mapping of beneficiaries based on their main needs and uses of information and on their relationship to main factors of vulnerability.	Number of beneficiaries mapping exercises completed in each country and for each sector. Number of successful capacity building programs for local stakeholders (including metrics of learning and appropriation). Number of studies reviewing successful case studies and lessons learned on stakeholders' engagement; review is aimed at identifying conditions for effective participation. Percentage of tasks and activities assigned and implemented in collaboration with communities.	Project Manager Executing Entities in each country
Lack of a clear gender perspective in ENANDES as a result of this perspective not being explicitly included in the results framework in terms of associated targets, indicators or baselines.	Incorporation of specific gender-related activities, targets and indicators in the results framework of ENANDES, following WMO's Gender Equality Policy	Number of project activities that explicitly assess gender-specific potential differences in access, comprehension and use of weather/climate information. Number of local adaptation activities that specifically strengthen women's access to information produced by ENANDES project, including gender-specific issues included in training efforts and workshops, amongst others. Number of women trained in accessing and interpreting weather/climate information produced by ENANDES.	Project Manager National Project Coordinators Implementing Entity National Executing Entities Executive Board
	Establishment of an ENANDES "Gender equity committee" in each country.	Number of gender-related issues brought before, or addressed by the ENANDES "Gender equity committees".	
Indigenous and peasant beneficiary families not being adequately informed and engaged to access the range of the project´s benefits.	Documentation of evidences, lessons learned and good practices for consultations to the rural communities with which the Project is going to develop collaborative activities.	No. of meetings held for consultations with rural communities with which the project is designing/developing activities. A document reviewing good practices and lessons learned to foster effective engagement of indigenous and peasant communities in co-designing local climate adaptation activities.	Project Manager National Project Coordinators National Executing Entities
Unexpected uses of information produced in the context of ENANDES could eventually result in new or increased socio-environmental conflicts.	Definition of a baseline derived from previous experiences on producing weather/climate information and that highlights relevant stakeholders, interests and potential conflicts.	Number of documents relating lessons learnt from previous experiences on producing climate/weather information and the kind of projects and interventions developed afterwards using such information/data.	Project Manager Implementing Entity National Executing Entities Executive Board
	An auditing unit including authorities responsible for land use planning, natural protected areas, and adaptation and GHG mitigation measures in demonstration sites.	Baseline and monitoring system of land uses, deforestation levels, natural protected areas, soil erosion, their main drivers and the enabling conditions for mitigation and adaptation measures.	Project Manager National Executing Entities

19.1 Grievance Mechanism

An important component of the ESRMP for ENANDES is the grievance mechanism (sometimes also referred to as "Stakeholder Response Mechanism"). This involves a set of procedures and processes that allow project participants or stakeholders to raise their concerns about possible ENANDES' non-compliance with its social or environmental policies or commitments. The ultimate goal is to be able to provide a rapid response, remediation or compensation if the project is having or has had a negative effect on one of its stakeholders.

Both the WMO and each national executing entities already have their own established grievance mechanisms. The following links contain the specific grievance mechanisms for each of them:

- WMO: https://public.wmo.int/en/about-us/planning-finance-accountability/internal-oversight-office/report-fraud-corruption-or-abuse
- DMC: https://www.dgac.gob.cl/oirs/
- IDEAM: http://www.ideam.gov.co/web/atencion-y-participacion-ciudadana/contactenos
- SENAMHI: https://www.senamhi.gob.pe/?&p=libro-reclamaciones

Most of these mechanisms can be accessed through institutional websites or in person at the national offices. To avoid duplication, ENANDES should keep these institutional mechanisms and communicate them so that project stakeholders know about these mechanisms and can use them if necessary. Information about the mechanisms should be prominent in an ENANDES web site (if implemented). In addition, ENANDES should include a grievance function/process in its various participation spaces, for instance at the "Mesas Técnicas Agroclimáticas", so that local stakeholders could also share their complaint within these spaces.

It will be the responsibility of the ENANDES Project Manager and National Steering Committees to ensure that all stakeholders are adequately informed of the existence of the grievance mechanism and how to access it. The ENANDES communication strategy should provide a detailed explanation of what grievance mechanisms mean, what their purposes are, and how stakeholders can access them. As part of effective communication, participants and stakeholders must be made aware that grievance processes are backed by proven, fair and reliable processes, that they are understandable and easy to access, and that they keep stakeholders informed about the progress of any issues. Finally, the mitigation measures identified in the ESRMP and incorporated into the proposal are a starting point to limit the type of risks that these grievance mechanisms would consider for evaluation and possibly remediation.

20 Project Monitoring and Evaluation (D)

The WMO, together with executing partners will ensure the timeliness and quality of ENANDES implementation by following well-established and widely accepted procedures for project monitoring and evaluation. *Monitoring* is the regular collection of information about all activities in a project. Monitoring shows whether project tasks are proceeding according to plans; it helps managers to identify and solve problems quickly. Monitoring is routinely carried out by project staff, project partners and peer educators as they keep track of their work. In contrast, the *evaluation* of a project is an assessment conducted as systematically and impartially as possible. An evaluation analyzes the level of achievement of both expected and unexpected results. An evaluation should provide credible, useful evidence that enables the timely incorporation of its findings, recommendations and lessons into the decision-making processes of organizations and stakeholders. Clearly, monitoring and evaluation are closely intertwined elements, as the information gathered during monitoring of a project directly informs subsequent evaluation efforts. Embedding monitoring processes into the initial design of a project and not as an afterthought is key to enabling subsequent evaluation. Monitoring and evaluation are discussed in the following sections.

20.1 Project Monitoring

ENANDES will adopt a two-pronged approach to project monitoring. First, monitoring of project activities will be routinely carried out by the Project Manager and the staff of executing partner institutions as they keep track of their work. Results from the internal ongoing monitoring will be routinely reported to management teams (at national or project-wide levels) and will facilitate the assembly of reports to the Adaptation Fund.

Second, a mixed approach will be followed in which (i) the monitoring process is designed and overseen by independent external consultants engaged at project inception, but (ii) the on-site activities such as the administration of surveys and questionnaires are actually conducted by project personnel at demonstration sites. At the start of the project, the external monitors will design surveys and questionnaires to refine preliminary baseline estimates of indicators (e.g., access to, and actual use of climate information). Additionally, the project's inception may be an opportune time to refine the originally proposed indicators of adaptation effectiveness as a function of interactions with stakeholders (e.g., during the planed project inception workshops). Subsequent external monitoring activities will be performed at least annually.

Periodic reports to the Adaptation Fund will be prepared as part of the project monitoring process. Reports will be submitted 3-4 times a year by the National Steering Committees and the CIIFEN/RCC-WSA to the Project Manager. An Annual Progress Report (APR) will be assembled by the ENANDES Project Manager with contributions from execution focal points and partners. The APR will describe activities carried out, outcomes and outputs, lessons learned, problems encountered and plans for the following period. The APR will report on compliance with the AF environmental and social assessment and management frameworks. An accompanying Financial Report will be prepared by WMO's administrative support team providing financial and procurement information. The APR will be evaluated by the ENANDES Executive Board and the External Advisory Board prior to submission to the Adaptation Fund, who will assess progress and achievements and recommend modifications to the original plans if necessary.

20.2 Project Evaluation

Robust, independent evaluation of adaptation projects seeks to provide information about to take stock of achievements and weaknesses, performance, impacts, good practices, and lessons learned. This learning contributes to improving the effectiveness of interventions and helps hold project partners accountable. ENANDES evaluation will be carried out in accordance with the UN Evaluation Group (UNEG) Norms and Standards adopted in 2005 and updated in 2016 (to which WMO adheres) and WMO practice. Additionally, ENANDES evaluation procedures will follow the recommendations originally proposed by the Development Assistance Committee (DAC) of the Organization for Economic Cooperation and Development (OECD) that are widely used in evaluations today, including the WMO [200]. These guidelines involve five main dimensions or criteria: (i) relevance, or the extent to which the intervention is suited to the priorities and policies of the target groups, recipients and donor; (ii) effectiveness, a measure of the extent to which an intervention attains its objectives; (iii) efficiency, a measure of the outputs – qualitative and quantitative – in relation to the inputs; (iv) impact, the positive and negative changes produced by the intervention, directly or indirectly, intended or unintended; and (v) sustainability, an estimate of whether the benefits of an activity are likely to continue after donor funding has been withdrawn. Other criteria may be added that are specific to ENANDES goals and objectives, e.g., cross-cutting dimensions like age and gender.

Project evaluations may be conceptually classified into two major categories, depending on their principal focus. If evaluators prioritize *accountability,* the review typically concentrates on achieved outcomes, and compare them with the outcomes envisioned in the project's implementation plan; this approach is often referred to as a *summative* review. On the other hand, if the review focuses on *learning,* the evaluation will concentrate on processes and context, and on the exploration of factors that have contributed to, or impeded the project's success; this alternative approach is a *formative* review. The ENANDES evaluation process will combine both approaches, that is, to assess effective progress but, at the same time, try to understand what

aspects of the project are working (or not) as planned and why. Assessment of outcomes will be complemented with narratives from the adaptation case studies describing "what went right?" and "what went wrong?" The assessment also will seek to monitor possible unintended effects and maladaptation.

Two external evaluations of ENANDES will be performed (i) around the midpoint of the project and (ii) at project completion to assess the project. External evaluation lends technical expertise and objectivity to the process. Both evaluations will be performed by one or two individuals who have not had any involvement in project activities. The Terms of Reference for external evaluations evaluation will be prepared by the WMO. The expert(s) engaged will have significant international professional experience in the field of implementation, follow-up, monitoring and evaluation of climate services and adaptation, ideally in developing countries. External evaluators will get project participants involved in the process, as long as objectivity is not jeopardized.

The Mid-term Evaluation (MTE) will determine progress made toward achievement of outcomes and assess financial, social and environmental risks. It will present initial lessons learned on project implementation and management. In particular, the MTE will pinpoint corrective actions as required. The findings of this evaluation will be incorporated as recommendations for enhanced implementation during the final half of the project's term. Most importantly, the MTE provides a timely opportunity to reflect about the sustainability of the project, as the end-of-project evaluation will not provide sufficient time for this purpose.

An End-of-Project External Evaluation (EOPEE) will be conducted shortly before the end of the Project's lifetime (2-3 months prior to the Project's end date) and shall be submitted no later than two months after the Evaluation is conducted. The EOPEE will assess the *entire* project (i.e., not only the second half), and will verify if corrections or modifications to plans suggested by the MTE were adopted and if they were successful. Moreover, the EOPEE will be expected to provide comments on already-implemented actions to ensure project sustainability and scale-up. The external evaluations will involve (i) a review of project and activity documentation, (ii) interviews with the ENANDES management team, project boards and national steering committees, participants and major beneficiaries of ENANDES support, and (iii) meetings with stakeholders in adaptation areas. The budget allocated for all monitoring activities is shown in Table 16.

Table 16. Estimated budget for project monitoring and evaluation activities.

Monitoring and Evaluation Activity	**Amount budgeted (USD)**
Project Reports	Included in Management costs
Annual External Project Monitoring	20,000
Mid-term External Evaluation	25,000
Terminal External Evaluation	40,000
Total Monitoring and Evaluation Costs	85,000

21 Project Results Framework (E)

Table 17. Results framework for ENANDES.

Expected Output/Outcome	Output/Outcome Indicator	Baseline (2019)	Target by End of Project	Means of Verification	Assumptions
Expected Outcome 1: Enhanced design, production and communication of climate/water information and services.	Categories assigned to NMHSs for each component of the WMO Checklist for Climate Services Indicators (CCSI). Relevant components include (i) Basic Systems, (ii) User Interface, (iii) Capacity Development, (iv) Provision and Application of Climate Services, and (v) Socio-Economic evaluation.	Classification received by ENANDES NMHSs during the recent survey of WMO members to develop a baseline of climate services delivery. This comprehensive checklist was filled out by the NMHSs of Chile, Peru and Colombia in 2018. See Annex 5.	Moving the classification of each ENANDES NMHS in the WMO Checklist for Climate Services Indicators at least one category up.	NMHSs will resubmit the WMO Checklist for climate services periodically during the project implementation and at project's end. Mid-Project External Evaluation. End-of-Project External Evaluation.	The self-assessment process through the WMO Checklist was conducted correctly and accurately describes NMHS capabilities. All ENANDES NMHSs are willing to periodically complete the WMO checklist.
Output 1.1. National climatic and hydrological data management systems have been enhanced and updated through improved/new tools and processes. WIGOS implementation has been supported.	No. of weather and hydrological stations in demonstration sites for which: (a) historical daily climate/water records have been imaged and digitized (number of records); (b) quality control has been performed. (c) data have been homogenized; and No. of documents with procedural guidelines and good practices about management of climate and water data.	Section on Observing networks, data and data management in the WMO CCSI identified the need for this output. Few datasets are registered in WMO Information System WIS.	All meteorological and hydrological stations within the demonstration areas have been subjected to gap analysis and national reports are available, including strategies to strengthen the observational network. A set of high-quality stations will be selected by some countries (Colombia) for subsequent analyses. All available records on paper support have been digitized for all or selected (Colombia) stations within demonstration areas. Other stations can be digitized if resources allow it. Data for all or selected (Colombia) meteorological and hydrological stations within the demonstration areas have been quality controlled. Data from other stations can be QCed if resources allow it.	Quarterly progress reports from national executing partners. NMHSs CCSI checklist. Mid-Project External Evaluation. End-of-Project External Evaluation.	

Expected Output/Outcome	Output/Outcome Indicator	Baseline (2019)	Target by End of Project	Means of Verification	Assumptions
			Procedures and guidelines are available for management of climate/water data and metadata. Periodic summaries are received by NMHSs on the operational status of each observation station.		
Output 1.2. The characterization and communication of historical and recent states of climatic hazards have been improved through new/enhanced tools and processes.	No. of products describing (a) climatological values or (b) current status of weather/water variables. No. of products describing extreme values of weather/water variables. No. of products showing derived climate/water indices to monitor recent conditions. No. of stakeholders who expressed favorable opinion about the climatological and diagnostic products provided by ENANDES.	Section on Observing networks, data and data management in the WMO CCSI identified the need for this output. Limited availability of organized information about extremes	Climatological (historical) values and diagnostic products of climatic variables and hazards is completed for the demonstration areas. Percentage of stakeholders expressing favorable opinions about products has increased by at least 25%.	Quarterly progress reports from national executing partners. NMHSs CCSI checklist. Surveys of users accessing climatological and diagnostics products.	
Output 1.3. The production and dissemination of forecasts of high-impact weather has been improved through new models and processes.	No. of tools or procedures implemented and tested to forecast extreme weather events, and that reflect the needs of users. No. of risk management stakeholders who expressed favorable opinion about the forecasts provided by ENANDES.	Section on forecasting systems in the WMO CCSI identified the need for this output. Weather forecasting systems focusing on multiple types of hazards do not exist.	Weather forecasting systems that focus on multiple types of hazards. Reduced uncertainty in weather forecasts.	Quarterly progress reports from national executing partners. Surveys of users of high-impact weather forecasts.	
Output 1.4. The production and dissemination of sub-seasonal to seasonal (S2S) predictions of regional climate and hydrological conditions has been improved	No. of products that show sub-seasonal and seasonal forecasts of expected regional climate conditions in demonstration sites. No. of metrics implemented to assess the skill of S2S forecasts.	Limited number of seasonal products are available. Very few products are available for sub-seasonal scales. Few forecast products have public reports describing performance	Sub-seasonal to seasonal products are generated and used for decision making in the demonstration areas and for priority sectors. S2S forecasts in the demonstration areas are registered in WIS.	Quarterly progress reports from national executing partners. Skill metrics for S2S forecasts estimated by NMHSs or CIIFEN/RCC-WSA.	Academic or research institutions are willing to collaborate with ENANDES NMHSs even if no specific funds were allocated to them.

Expected Output/Outcome	Output/Outcome Indicator	Baseline (2019)	Target by End of Project	Means of Verification	Assumptions
through new models and processes.		evaluation and quantification of uncertainties.	Values of metrics used to assess the skill of S2S forecasts have improved by project's end.		
Output 1.5: The access, processing and dissemination of multi-model projections of regional climate change (decadal to multi-decadal) from multiple institutions and models has been made easier by the development of suitable tools.	No. of tools developed to facilitate NMHS access to climate change projections. No. of institutions and/or models for which projections have been made available.	Each NMHS has to develop its own approaches to fetch and analyze projections of regional climate change from multiple institutions and models.	Tools have been implemented and shared among ENANDES NMHSs to fetch and analyze projections of regional climate change from multiple institutions and models.	Quarterly progress reports from national executing partners.	Academic or research institutions are willing to collaborate with ENANDES NMHSs.
Output 1.6: Procedures and tools have been implemented by NMHSs to downscale seasonal forecasts and climate change projections in space/time. Global forecasts/projections have been calibrated for the ENANDES region.	No. of tools implemented to downscale seasonal forecasts in space/time. No. of tools and products showing bias-corrected seasonal forecasts and climate change projections.	No region-specific calibration procedures of climate forecast outputs performed in this region Collaboration with academia/research institutions to improve forecasting systems and products is limited.	Seasonal forecasts downscaled, at least for demonstration adaptation areas. Bias-corrected forecasts and climate change projections available, at least for demonstration sites. The number of academia/research institutions collaborating with NMHSs on forecasting systems has increased at least by 33%.	Quarterly progress reports from national executing partners.	Academic or research institutions are willing to collaborate with ENANDES NMHSs.

Expected Output/Outcome	Output/Outcome Indicator	Baseline (2019)	Target by End of Project	Means of Verification	Assumptions
Expected Outcome 2: Strengthened institutional coordination and value-adding tools and processes allow climate/weather information to be tailored and translated into user-centric and sector-specific adaptation actions.	Components of a National Framework for Climate Services to which ENANDES has made contributions. No. of formal agreements with different institutions from climate-sensitive sectors. No. of sectoral models used to translate climate conditions into expected outcomes.	Weak institutional coordination and articulation. NMHSs have no operational mechanism for stakeholder engagement at national/local levels. Mechanisms for NMHSs to receive stakeholder feedbacks on products/services are limited. Tools and mechanisms to translate and tailor climate information are not integrated into NMHS operational procedures.	All relevant stakeholders have been approached and invited to participate in ENANDES. All institutions who agreed to participate in ENANDES have remained engaged and making contributions to the project.	Formal agreements filed with executing entities. Documents shared and filed by the project manager	All the relevant stakeholders identified by ENANDES are willing to participate in the implementation of the project
Output 2.1: Knowledge and action networks have been implemented that facilitate the design, production, delivery, and use of climate information and services; relevant strategic partners have been engaged; capability gaps in strategic partners have been identified and addressed.	Maps of stakeholders in each demonstration area, including roles, functions and relevance to ENANDES (Yes/No). No. of stakeholder mapping exercises completed in each country and for each sector. No. of sectoral institutions approached as potential ENANDES partners. No. of stakeholder institutions in which women play an important role (high percentage of membership, positions in organization, gender perspective is explicitly considered). No. of formal agreements signed with potential ENANDES partners from multiple sectors. No. of lessons learned regarding successful local participation platforms and processes.	No regular interactions with users to identify requirements are in place Sporadic assistance to users to interpret/use climate predictions and products. Weak relationship and communication channels with users.	Maps of stakeholders with relevant regional, national subnational and local strategic partners completed for each demonstration area and reported. No. of stakeholder institutions in which women play an important role has increased by at least 1/3 since baseline. A document reviewing good practices and lessons learned to foster effective engagement of indigenous and peasant communities in co-designing local climate adaptation activities.	Quarterly progress reports from national executing partners. Project Manager. Reports from Field Schools and Roving Seminars. Database of stakeholders.	Local partners can assist in identification of all potentially relevant stakeholders.
Output 2.2: The needs for tailored weather/climate information have been identified for target	No. of "mental models" studies of climate perceptions to learn what stakeholders know or think they know about their climate.	A gap exists between the information developed by NMHSs and the needs of users.	A document reviewing good practices and lessons learned to foster effective engagement of indigenous and peasant communities in	Quarterly progress reports from national executing partners. Project Manager. Periodic surveys of users of different types in	

Expected Output/Outcome	Output/Outcome Indicator	Baseline (2019)	Target by End of Project	Means of Verification	Assumptions
sectors in demonstration adaptation regions.	No. of interactions with stakeholders to discuss needs and expectations and to show available climate services. No. of climate products for which original and/or revised design/formats has been discussed with stakeholders/partners. No. of project activities that explicitly assess gender-specific potential differences in access, comprehension and use of weather/climate information. Percentage of users surveyed who report satisfaction with the contents of services provided. Percentage of users surveyed who report understanding of the information produced. Percentage of users surveyed who report having used the information produced to modify any of their decisions/actions.	Limited mechanisms in place for evaluating users' uptake and satisfaction about products/services. No mechanism in place to receive feedback about climate products/services on a regular basis.	co-designing local climate adaptation plans and activities and necessary climate services.	demonstration sites or elsewhere in ENANDES countries. Feedback received through electronic interactions (web sites, social networks).	
Output 2.3: Sectoral models have been used to "translate" observed/predicted weather/climate conditions into likely local impacts at demonstration sites.	No. of statistical or process models implemented to convert sub-seasonal and seasonal forecasts into sectoral outcomes. Results of calibration/validation analyses for "translation" models in demonstration areas. No. of consultations with local authorities, resource managers or technical advisors to judge appropriateness of the climate-impacts linkages established. No. of consultations in which peasants and indigenous communities have contributed local knowledge to "translation" of impacts in the absence of process models. No. of consultations with users on perceived significant impact thresholds for climate risks.	Limited experience in operational linkage of climate information with process models (hydrological, agronomic). Limited availability of agroclimatic indices for some of the demonstration sites. Limited assessment of agroclimatic risks.	Agroclimatic reports for main crops in demonstration sites. Assessment of agroclimatic risks for demonstration sites.	Quarterly progress reports from national executing partners. Project Manager.	
Output 2.4: Communication and knowledge management strategies have been developed for ENANDES. Relevant information about observed/predicted	No. of outreach efforts conducted each month (general audience articles, short videos, web site articles, blog entries, presentations at public fora). Broken down by month/year. No. of messages, products (diagnostics, forecasts), and warnings disseminated via	Insufficient mechanisms to exchange quality information among institutions at regional, national and subnational level Lack of context-specific communication channels	At least 10 outreach actions per month during ENANDES lifetime. Content of ENANDES web site, blog or social networks updated at least six times per month.	Quarterly progress reports from national executing partners. Project Manager. Web and social media analytics. Reports on outreach activities.	A dedicated web site will be created for ENANDES and content updated regularly. Social media accounts will be created for

Expected Output/Outcome	Output/Outcome Indicator	Baseline (2019)	Target by End of Project	Means of Verification	Assumptions
weather/climate hazards and their likely impacts are routinely communicated through appropriate channels.	various media (email, social networks, web, radio, TV, SMS). Broken down by month/year. Access statistics for ENANDES and NMHSs web sites (for NMHSs, sections related to ENANDES). Breakdown by location, month, year. No. of products, tutorials or any other electronic content downloaded. Breakdown by location, time. No. of social media entries liked, re-sent, or commented. No. of local women playing important roles in disseminating climate information to their communities. No. of members of indigenous or peasant communities playing important roles in disseminating climate information to their peers.	to facilitate close interactions between			EANNDES and content updated regularly.
Output 2.5: Multiple requisites of a National Framework for Climate Services, such as identification of stakeholders and information needs and implementation of national dialogs, have been addressed by ENANDES, thus contributing to NFCS implementation.	No. of meetings coordinated in relation to NFCS planning. No. of steps/activities completed in the GFCS protocol for NFCS. No. of agreements and protocols established to support NFCS.		At least 80% of NFCS steps have received specific contributions from ENANDES activities. The outline and general structure of national Strategic Plans for NFCS implementation have been completed.	Quarterly progress reports from national executing partners. Communication with NFCS committees by Project Manager.	ENANDES participants participate actively in the NFCS process in each country.
Expected Outcome 3: Engaged and empowered stakeholders have participated in the co-development and implementation of local plans and activities for adaptation to climate variability and change that rely on	No. of community adaptation plans that integrate climate and weather information. No. of early warning systems in place. Estimated socio-economic benefits of climate services and adaptation actions.	Isolated adaptation actions implemented in areas of the ENANDES region by previous initiatives. Very few of these activities are operationalized.	All local adaptation actions proposed in ENANDES have been implemented. Socio-economic benefits (SEB) of demonstration adaptation actions have been estimated, at least for one action in each demonstration area. Women and indigenous/peasant	Periodic report by the national executing partners. Reports from SEB studies. Reports form participatory and training activities disaggregated by gender and vulnerable communities.	All relevant stakeholders and beneficiaries have been adequately identified. Key stakeholders and beneficiaries are willing to participate in the

Expected Output/Outcome	Output/Outcome Indicator	Baseline (2019)	Target by End of Project	Means of Verification	Assumptions
climate/water information.			communities have had comparable participation and leadership in all adaptation activities.		adaptation and training actions.
Output 3.1: The factors that determine vulnerability to climatic variability and change have been identified for the sectors and regions targeted.	No. of vulnerability assessments performed in demonstration adaptation region. No. of earlier vulnerability studies or publications reviewed. No. of vulnerability-reduction actions that resulted or emerged from these assessments. No. of vulnerability-reduction actions resulting from these assessments that represent contributions from local knowledge and expertise.	Earlier studies in demonstration regions may have produced useful information on vulnerability.	ALL demonstration adaptation areas have undergone vulnerability assessments.	Quarterly progress reports from national executing partners.	Government institutions (national or local) will make available some types of data needed for vulnerability assessments (e.g., recent census data, property cadaster, etc.),
Output 3.2: Capacity building and outreach efforts have improved the accessibility, comprehension and use of climate and water information for risk management and adaptation among local stakeholders and communities.	No. of "field schools" conducted in demonstration adaptation sites. No. of "Roving Seminars" conducted in demonstration adaptation sites. No. of participants attending field schools and Roving Seminars, broken down by gender, age or ethnicity. Metrics of learning and appropriation for field schools and Roving Seminars. No. of women trained in accessing and interpreting information produced by ENANDES. No. of members from peasant/indigenous communities trained in accessing and interpreting information produced by ENANDES. No. of previously published studies reviewed to identify successful case studies and good practices for stakeholders' engagement (including gender and ethnicity dimensions); review is aimed at identifying conditions for effective participation prior to ENANDES activities. Has a document been produced reviewing good practices and lessons learned during ENANDES about how to foster effective	No field schools or Roving Seminars have taken place yet in adaptation sites.	At least one field school per project year, targeting local authorities and leaders of community organizations, including significant participation by women and members of different communities. A document has been produced reviewing good practices and lessons learned during ENANDES about how to foster effective engagement of vulnerable groups (e.g., rural communities, women's groups) in co-designing local climate adaptation activities.	Quarterly progress reports from national executing partners. Formal assessment reports of "field schools" and Roving Seminars. Project Manager.	Local authorities and leaders of community organizations are willing to attend the field schools.

Expected Output/Outcome	Output/Outcome Indicator	Baseline (2019)	Target by End of Project	Means of Verification	Assumptions
	engagement of vulnerable groups (e.g., peasant and indigenous communities, women's groups) in co-designing local climate adaptation plans and activities? (Yes/No).				
Output 3.3: Context-appropriate preparedness and adaptation plans and actions to reduce local damages from climate variability and change have been designed through participatory processes. Demonstration projects have been implemented and monitored to test those plans and actions.	Project Inception Workshops (PIWs) conducted in all demonstration sites (Yes/No). No. of stakeholders/partners attending PIW (broken down by gender, age, ethnicity). Reports from PIWs prepared and disseminated (Yes/No). No. of meetings held for consultations with the rural communities which will be involved in co-designing and implementing local adaptation activities. No. of meetings held for consultations with women groups which will be involved in co-designing and implementing local adaptation activities. No. of meetings with execution partners and local stakeholders (including peasant and indigenous communities & women's groups) to co-design adaptation activities in each demonstration area (broken down by gender/ethnicity). No. of local adaptation activities implemented in each demonstration site. No. of local adaptation activities that specifically address possible gender-specific differences in access, comprehension and use of ENANDES climate information (not Chile). No. of stakeholders who are engaged in demonstration adaptation activities in any way (numbers broken down by gender, age, ethnicity and vulnerability). Percentage of tasks and activities assigned and implemented in collaboration with local communities. N° of communities contributing with their local or traditional knowledge to the adaptation planning processes.	No Project Inception Workshops have taken place yet.	ALL PIWs held. All PIW reports completed and disseminated. All local adaptation activities planned for each demonstration site have been implemented.	Quarterly progress reports from national executing partners. Triangulation with local stakeholders and partners.	

Expected Output/Outcome	Output/Outcome Indicator	Baseline (2019)	Target by End of Project	Means of Verification	Assumptions
	N° of good practices in climate change adaptation implemented by women and considered for local adaptation plans. N° of technical working groups on climate and agriculture that involve participation of indigenous peoples.				
Output 3.4: Early-warning systems and enhanced processes for inter-institutional coordination have (i) strengthened national/local management of risks and (ii) have reduced the negative impacts of droughts and floods for demonstration adaptation sites/sectors.	No. of early warning systems (EWSs) implemented in demonstration adaptation areas (Note: Peru does not seek to reach full implementation of an EWS; this country will develop an advanced prototype). No. of alerts/warnings issued by each EWS. Broken down by month, year. Performance statistics for each EWS (hits, misses, false alarms in particular). No. of stakeholders who (i) have heard about the existence of EWSs in their demonstration sites, or (ii) have received alerts or information from those EWSs (Numbers broken down by gender, age and ethnicity) (Not Chile). No. of stakeholders who expressed favorable opinion about the info provided by the EWS. No. of stakeholders and institutions who have taken any kind of action in response to a warning received. Magnitude of losses reduced through provision of climate services and information.	Number of active or inactive (but which existed) early warning systems in demonstration adaptation areas.	At least one EWS implemented per country that intends to implement them (except Peru). At least 50% of stakeholders and 75% of institutions have taken any kind of action in response to a warning received from an EWS.	Quarterly progress reports from national executing partners. Project Management Office. Periodic project tracking efforts (surveys, questionnaires, focus groups). Surveys of users receiving early warnings.	ENANDES partners and stakeholders participate actively in the design and implementation of an EWS.
Output 3.5: Evaluations of the socio-economic benefits of ENANDES demonstration adaptation actions have been carried out.	No. of SEB studies conducted. No. of reports produced with SEB results. No. of general audience communications about SEB progress and results (not Chile).	No SEB studies in adaptation sites have taken place yet.	At least ONE SEB per demonstration site. At least ONE SEB report produced per demonstration site.	Quarterly progress reports from national executing partners. Project Management Office.	A consensus methodology has been defined by participants in SEB planning workshop convened by CIIFEN/RCC-WSA.

Expected Output/Outcome	Output/Outcome Indicator	Baseline (2019)	Target by End of Project	Means of Verification	Assumptions
Output 3.6: Useful lessons on local adaptation actions have been provided by an active project tracking effort (complementary to M&E efforts) that allowed active adaptation of goals, outcomes and outputs throughout the project.	No. of tracking activities performed (surveys, questionnaires, focus groups).	No tracking efforts have taken place yet.	Tracking activities and analyses of results performed at least twice per project year.	Quarterly progress reports from national executing partners.	Executing partners and adaptation site stakeholders will be provided clear guidelines on project tracking (to be developed by Project Manager) at Project Inception Workshop.
Expected Outcome 4: Regional and global coordination and cooperation mechanisms are strengthened; lessons, tools and approaches from ENANDES help others to provide climate services and replicate adaptation actions elsewhere.	No. of national weather stations for which data are freely shared among ENANDES participants. No. of meetings held by the active regional technical groups No. of training activities implemented by the ENANDES Project No. of meetings held to coordinate activities between Regional Training Centers and NMHSs. No. of adaptation actions replicated outside demonstration areas in ENANDES countries, and in neighboring countries.	Limited regional exchange of climate data exists, limit interoperability of regional databases needs to be updated. Regional technical groups are not active in the region. Human capacities of the NMHSs are insufficient to support operational climate services production. Limited coordination among WMO regional Training centers and NMHSs. Procedures defined to coordinate activities between regional training centers and NMHSs.	All active stations are shared One meeting per project year has been convened for each Regional Working Training Group. Five training activities completed and evaluated during ENANDES implementation. RTCs and ENANDES NMHSs have met virtually at least twice a year for coordination purposes. At least five adaptation actions replicated outside ENANDES demonstration areas.	Reports and information produced by NMHSs Program Manager communication with stakeholders outside ENANDES areas.	NMHSs are willing to share data with other ENANDES partners Outreach activities generate interest in key stakeholders for replicating ENANDES activities and adaptation actions.
Output 4.1: Regional coordination activities (syntheses of surveys and needs, regional expert meetings) have been carried out to support the update of national climatic and hydrological data management systems,	The synthesis of weather station assessments performed by each country has been completed and published by CIIFEN/RCC-WSA (Yes/No). The synthesis of national plans for climate data management activities performed by each country has been completed and published by CIIFEN/RCC-WSA (Yes/No).	Section on Observing networks, data and data management in the WMO CCSI identified the need for this output. All ENANDES NMHSs have expressed some dissatisfaction with their current climate data management system.	Synthesis of weather station assessments performed by each country completed and published by CIIFEN/RCC-WSA (Yes/No). Synthesis of national plans for climate data management activities has been completed and published by CIIFEN/RCC-WSA (Yes/No).	Quarterly progress reports from CIIFEN/RCC-WSA.	NMHSs have performed their assessment (gap analysis) of weather stations in a timely and consistent manner to allow synthesis by the RCC.

Expected Output/Outcome	Output/Outcome Indicator	Baseline (2019)	Target by End of Project	Means of Verification	Assumptions
and the implementation of interoperable regional databases.	No. of global or regional gridded climate data sets compiled.	Few datasets from ENANDES region are registered in WMO Information System WIS. Limited numbers of global or regional gridded datasets available to NMHSs.	At least 20 global or regional gridded data sets compiled for different climate variables.		NMHSs have performed their assessment of climate data management needs in a timely and consistent manner to allow synthesis by the RCC. ENANDES NMHSs have reached consensus on a priority list of gridded climate data sets (i.e.., which ones are most needed/used).
Output 4.2: Regional coordination activities (consultations, expert meetings) have been carried out to support to support and complement national strengthening of capacities for climate monitoring and prediction.	No. of tools developed to facilitate access to seasonal forecast and climate projections from global centers.	No regional or widely shared tools exist to access seasonal forecast and climate projections from global centers.	Access tools have been developed to access seasonal forecast and climate projections from at least 5 global centers.	Quarterly progress reports from CIIFEN/RCC-WSA.	ENANDES NMHSs have reached consensus on a priority list of desired climate forecasts and projections.
Output 4.3: Regional coordination activities (consultations, expert meetings) have been carried out to support and complement national strengthening of capacities for climate services production, dissemination and uptake.	No. of volunteer weather/water observers engaged. Workshop to review SEB approaches and reach consensus has been conducted (Yes/No). Collation/publication of best practices on implementation of climate services in western South America completed (Yes/No).	Some volunteer observing networks exist. No compilation of best practices on implementation of climate services in the region is available.	At least 20 observers in each site where volunteers are sought. A workshop has been conducted to review SEB approaches and reach consensus.	Reports from local stakeholders/partners. Quarterly progress reports from CIIFEN/RCC-WSA.	Non-ENANDES funds are available to purchase equipment necessary to conduct observations.
Output 4.4: Regional Technical Working Groups have been established, re-	No. of Regional Technical Working Groups (RTWGs) coordinated each year.	Regional Technical Working Groups exist, but some have had limited	At least three Regional Technical Working Groups are functioning (meeting regularly, defining common	Quarterly progress reports from CIIFEN/RCC-WSA.	NMHSs from ENANDES and other countries in WMO Region III will allow

Expected Output/Outcome	Output/Outcome Indicator	Baseline (2019)	Target by End of Project	Means of Verification	Assumptions
convened or revitalized. Active liaison with other ongoing projects in the region has achieved positive synergies and enhanced economic efficiency.	No. of specific actions or activities completed by RTWGs.	recent activity or have been completely inactive.	activities) in western South America. At least three new actions have been addressed by each active RTWG.	Interactions with RTWG members by Project Manager and CIIFEN/RCC-WSA. Mid-Project External Evaluation. End-of-Project External Evaluation.	their experts to be involved in Regional Technical Working Groups.
Output 4.5: A Climate Services Toolkit (CST) has been implemented that is tailored to the previously determined operational needs of ENANDES NMHSs.	Has a coding style guide been published for CST tools? (Yes/No). Have documentation guidelines and template been produced for CST tools? (Yes/No). No. of ENANDES tools implemented and documented within a CST. No. of technical experts participating in development of CST tools (broken down by country, age and gender).	An ENANDES CST does not exist.	At least 80% of tools in CST have been coded according to the style guidelines provided. A tool in the CST should be available for at least 60% of products (diagnostics, forecasts) produced by ENANDES. All tools in the CST have been documented according to guidelines provided; examples of use have been provided.	Quarterly progress reports from CIIFEN/RCC-WSA. Mid-Project External Evaluation. End-of-Project External Evaluation.	ENANDES NMHSs will allow their information technology staff to collaborate with one another in development of the ENANDES CST under the coordination of CIIFEN/RCC- WSA.
Output 4.6: Capacity building efforts for ENANDES have been defined by ENANDES participants and jointly implemented by WMO Regional Training Centers, WMO Training Activities Division and other institutions.	Has a workshop to reach consensus on training needs and priorities been convened? (Yes/No). Has a summary report been produced form this workshop? (Yes/No). No. of coordination meetings between NMHSs and WMO Iberoamerican Regional Training Centers. No. of people attending in-person training efforts (broken down by gender). No. of people completing virtual training efforts (broken down by gender). Has a consultant been identified and tasked with formal assessment of training activities? (Yes/No). Proportion of training efforts that have been evaluated using accepted procedures and metrics. No. of training efforts developed by ENANDES that have been used by institutions outside the project (e.g., by a WMO RTC).	No ENANDES training efforts have taken place yet. Limited coordination exists among NMHSs and WMO RTCs.	At least five coordination meetings between NMHSs and WMO Iberoamerican Regional Training Centers have taken place. At least two in-person courses and three virtual courses on topics to be defined by consensus among ENANDES partners. All ENANDES training efforts have been formally assessed using accepted procedures and metrics. Results from assessment of training efforts provided to Project Manager and National Steering Committees.	Quarterly progress reports from CIIFEN/RCC-WSA. Surveys or exit interviews held with participants in capacity building efforts. Mid-Project External Evaluation. End-of-Project External Evaluation.	WMO Iberoamerican Regional Training Centers are willing to coordinate activities with ENANDES. Capacity building needs have been identified by other AR III countries.

22 Project Alignment with the Results Framework of the Adaptation Fund (F)

Table 18. Results framework for the ENANDES Project.

Project Objective	Project Objective Indicator(s)	Fund Outcome	Fund Outcome Indicator	Grant Amount (USD)
To enhance the capacity of society and communities in Chile, Colombia and Peru to adapt to a varying and changing climate, reducing vulnerabilities and enhancing resilience.	Relevant weather/climate information tailored to specific sectors generated and disseminated to stakeholders operationally. Categories assigned to ENANDES NMHSs for each component of the WMO Checklist for Climate Services Indicators (CCSI). Relevant components include (i) Basic Systems, (ii) User Interface, (iii) Capacity Development, (iv) Provision and Application of Climate Services, and (v) Socio-Economic evaluation. Scores of ENANDES NMHSs in WMO Climate Services Capabilities Checklist. No. of early warning systems developed.	**Outcome 1.** Reduced exposure at national level to climate-related hazards and threats.	**Indicator 1.** Relevant threat and hazard information generated and disseminated to stakeholders on a timely basis.	3,050,325
To co-create, implement and assess context-appropriate local adaptation practices to boost the resilience of communities to climatic hazards and empower local actors and institutions to mitigate the impacts of extreme weather, climate variability and change.	Implementation of early warning systems.	**Outcome 2.** Strengthened institutional capacity to reduce risks associated with climate-induced socioeconomic and environmental losses. **Outcome 3.** Strengthened awareness and ownership of adaptation and climate risk reduction processes at local level. **Outcome 4.** Increased adaptive capacity within relevant development and natural resource sectors. **Outcome 6.** Diversified and strengthened livelihoods and sources of income for vulnerable people in targeted areas	**Indicator 2.1.** No. and type of targeted institutions with increased capacity to minimize exposure to climate variability risks. **Indicator 2.2.** No. of people with reduced risk to extreme weather events. **Indicator 3.1.** Percentage of targeted population aware of predicted adverse impacts of climate change, and of appropriate responses. **Indicator 3.2.** Modification of behavior in targeted population. **Indicator 4.1.** Development sectors' services responsive to evolving needs from changing and variable climate.	2,074,675
To enhance coordination and planning among participating countries to maximize positive synergies and increase the project's economic		**Outcome 2.** Strengthened institutional capacity to reduce risks associated with climate-induced socioeconomic and environmental losses.	**Indicator 2.1.** No. and type of targeted institutions with increased capacity to minimize exposure to climate variability risks **Indicator 2.2.** No. of people with reduced risk to extreme weather events	1,075,000

efficiency, ultimately facilitating replication and scale-up in other contexts.		**Outcome 6.** Diversified and strengthened livelihoods and sources of income for vulnerable people in targeted areas	**Indicator 6.1.** Percentage of households and communities having more secure (increased) access to livelihood assets. **Indicator 6.2.** Percentage of targeted population with sustained climate-resilient livelihoods.	
Project Outcome(s)	**Project Outcome Indicator(s)**	**Adaptation Fund Output**	**Adaptation Fund Output Indicator**	**Grant Amount (USD)**
Outcome 1: Enhanced design, production and communication of climate/water information and services.	Relevant categories of the WMO Checklist for Climate Services Indicators (CCSI): Basic Systems, User Interface, Capacity Development, Provision and Application of Climate Services, Socio-Economic evaluation.	**Output 2.1.** Strengthened capacity of national and regional centers and networks to respond rapidly to extreme weather events.	**Indicator 2.1.1.** No. of staff trained to respond to, and mitigate impacts of, climate-related events.	1,879,065
Outcome 2: Strengthened institutional coordination and value-adding tools and processes allow climate/weather information to be tailored and translated into user-centric and sector-specific adaptation actions.	No. of formal agreements with different institutions from climate-sensitive sectors. No. of tools available for translating climate diagnostics and forecasts into likely sectoral outcomes.	**Output 1.** Risk and vulnerability assessments conducted and updated at a national level. **Output 2.1.** Strengthened capacity of national and regional centers and networks to respond rapidly to extreme weather events.	**Indicator 1.1.** No. and type of projects that conduct and update risk and vulnerability assessment **Indicator 1.2.** Development of early warning systems. **Indicator 2.1.1.** No. of staff trained to respond to, and mitigate impacts of, climate-related events.	1,171,260
Outcome 3: Engaged and empowered stakeholders have participated in the co-development and implementation of local plans and activities for adaptation to climate variability and change that rely on climate/water information.	No. of community adaptation plans that integrate climate and weather information. No. of early warning systems in place. No. of vulnerability assessments performed in demonstration adaptation region. No. of earlier vulnerability studies or publications reviewed. No. of participants attending field schools, broken down by gender, age or ethnicity. No. of women trained in accessing and interpreting weather/climate information produced by ENANDES.	**Output 2.2.** Targeted population groups covered by adequate risk reduction systems. **Output 3.** Targeted population groups participating in adaptation and risk reduction awareness activities. **Outcome 4.** Increased adaptive capacity within relevant development and natural resource sectors. **Output 6.** Targeted individual and community livelihood strategies strengthened in relation to climate change impacts, including variability.	**Indicator 2.2.1**. Percentage of population covered by adequate risk-reduction systems. **Indicator 2.2.2**. No. of people affected by climate variability **Indicator 3.1.1.** No. and type of risk reduction actions or strategies introduced at local level. **Indicator 3.1.2.** No. of news outlets in the local press and media that have covered the topic. **Indicator 4.1.1.** No. and type of health or social infrastructure developed or modified to respond to new conditions resulting from climate variability and change. **Indicator 6.1.2.** Type of income sources for households generated under climate change scenario.	2,074,675

Outcome 4: Regional and global coordination and cooperation mechanisms are strengthened; lessons, tools and approaches from ENANDES help others to provide climate services and replicate adaptation actions elsewhere.	No. of national weather stations for which data are freely shared among ENANDES participants. No. of meetings held by the active regional technical groups. No. of training activities implemented by the ENANDES Project. No. of meetings held to coordinate activities between Regional Training Centers and NMHSs. No. of adaptation actions replicated outside demonstration sites in ENANDES countries, and other countries.	**Output 2.1**. Strengthened capacity of national and regional centers and networks to respond rapidly to extreme weather events. **Output 6.** Targeted individual and community livelihood strategies strengthened in relation to climate change impacts, including variability.	**Indicator 2.1.1.** No. of staff trained to respond to, and mitigate impacts of, climate-related events. **Indicator 6.1.2**. Type of income sources for households generated under climate change scenario.	1,075,000

23 Detailed Project Budget (G)

Table 19. Breakdown of budget by output and institution. The "WMO" column includes funds allocated by all partners for common purposes, such as (i) supporting inter-institutional visits, workshops and internships, (ii) funding all training efforts, (iii) supporting WMO experts and Letters of Agreement with other partners in the project; and (iv) conducting the socio-economic-benefit studies.

Outcome/Output	Chile	Colombia	Peru	CIIFEN	WMO	TOTAL per output
Outcome 1						
Output 1.1	180,000	146,428	159,829	-	95,000	581,257
Output 1.2	22,500	90,000	91,979	-	95,000	299,479
Output 1.3	45,000	175,200	62,425	-	145,000	427,625
Output 1.4	90,000	-	64,222	-	150,000	304,222
Output 1.5	67,500	-	-	-	70,000	137,500
Output 1.6	45,000	-	8,982	-	75,000	128,982
TOTAL Outcome 1	450,000	411,628	387,437	-	630,000	1,879,065
Outcome 2						
Output 2.1	36,000	30,000	104,042	-	10,000	180,042
Output 2.2	48,000	30,000	28,443	-	60,000	166,443
Output 2.3	48,000	30,000	27,832	-	65,000	170,832
Output 2.4	48,000	120,000	118,563	-	55,000	341,563
Output 2.5	60,000	96,000	66,380	-	90,000	312,380
TOTAL Outcome 2	240,000	306,000	345,260	-	280,000	1,171,260
Outcome 3						
Output 3.1	27,500	25,600	149,701	-	40,000	242,801
Output 3.2	82,500	72,000	15,796	-	70,000	240,296
Output 3.3	66,000	60,000	82,997	-	65,000	273,997
Output 3.4	247,500	214,772	180,060	-	135,000	777,332
Output 3.5	55,000	40,000	98,749	-	100,000	293,749
Output 3.6	71,500	130,000	-	-	45,000	246,500
TOTAL Outcome 3	550,000	542,372	527,303	-	455,000	2,074,675
Outcome 4						
Output 4.1	-	-	-	60,000	-	60,000
Output 4.2	20,000	-	-	140,000	30,000	190,000
Output 4.3	-	-	-	150,000	15,000	165,000
Output 4.4	-	-	-	300,000	5,000	305,000
Output 4.5	-	-	-	100,000	75,000	175,000
Output 4.6	-	-	-	150,000	30,000	180,000
TOTAL Outcome 4	20,000	-	-	900,000	155,000	1,075,000
TOTAL Project Activities	1,260,000	1,260,000	1,260,000	900,000	1,520,000	6,200,000
Activities + Project Management						6,850,000

Outcome/Output	Chile	Colombia	Peru	CIIFEN	WMO	TOTAL per output
Implementing Entity Fee (8.5%)						582,250
TOTAL Amount Requested						**7,432,250**

23.1 Budget Notes

Output	Note	% of Outcome Budget
1.1	Country level actions performed by NMHSs and technical stakeholders. WMO will support with expertise. International consultancy services, experts' travel, training activities for three countries in core NMHS competences.	30.9
1.2	Based on "Climate Watch" WMO procedures, and on Extreme Weather and Climate monitoring. Evaluation hazards. International consultancy services, product development, training, meetings with technical stakeholders.	15.9
1.3	Improvement of Numerical Weather Prediction for extreme weather events. International consulting services, external advice and intra-region support. Workshops and trainings.	22.8
1.4	WMO and IDEAM will lead activities and will coordinate with key external partners. National and International consultancy services. Regional trainings and workshops. 1Consultancy services. Regional trainings and workshops.	16.2
1.5	WMO and South and North American experts. Consultancy services. Workshops and training.	7.3
1.6	WMO and IDEAM with regional and external technical experts. Workshops and trainings.	6.9
2.1	Workshops with NMHSs and national institutions. Peru has budgeted for more activities because the Huallaga demonstration area has not been targeted by previous work.	15.4
2.2	Implementation of Mesas Técnicas Agrícolas and other community groups and platforms. Workshops and national meetings to define user requirements for climate services. WMO support.	14.2
2.3	WMO and external experts would support implementation. Technical developments to support Output 2.2. Consultancy services to support decision making at sectoral level, including provision of crop models. Workshops at national level.	14.5
2.4	Consultancy services in communication and gender perspective by national experts. National meetings with stakeholders. Training at local level. Colombia and Peru budgeted higher amounts because demonstration regions are far from the capital and are larger than in Chile. WMO and regional experts' contribution also budgeted.	29.2
2.5	Support on NFCS by WMO experts and national consultancy services. Development of NFCS plans. National and international consultancy services to develop UIP and implement CSIS.	26.7
3.1	A three-year process will refine community studies. Budget includes local meetings and consultancy services.	11.7
3.2	Field and community activities conducted by multidisciplinary experts. Activities related to gender and vulnerable communities are included. Workshops, local training and national consultancies	11.6
3.3	National consultancies in risk management, gender and community adaptation plans. National workshops at local level. One regional expert contribution budgeted.	13.2
3.4	Early Warning System at community level on drought and floods by NMHS and country institutions. National and international consultancy services. National workshops.	37.5
3.5	SEB studies per sector and pilot by national consultants. International consultancy services to provide regional and global expertise and to harmonize national activities. Field trips and interviews at community level.	14.2

3.6	Leverage of M&E activities per countries to refine project implementation methodology and propose corrective or improvement measurements. National or regional consultancy services, surveys and field visits.	11.8
4.1	CIIFEN/RCC/WSA will synthesize regional baseline from national analyses. Consultancy services, travel and one national meeting per country.	5.6
4.2	Support to Outputs 1.4, 1.5 and 1.6 at regional levels. Consultancy services. Workshops and training.	17.7
4.3	Consultancy services, minor equipment purchase, documentation and regional consultations.	15.3
4.4	Support to CIIFEN/RCC/WSA implementation plan. Regional consultancy services, regional travel, and regional meetings. Documentation development costs.	28.4
4.5	Regional contribution to CSIS, including Climate Services Toolkit. Regional consultancy services including regional travel for IT experts from NMHSs. One regional meeting. Documentation development costs.	16.3
4.6	Training activities by WMO Secretariat and Regional Training Centers. Travel for classroom-based training participants. Assessment and documentation.	16.7

Table 20. Annual breakdown of project execution costs. All amounts expressed in US dollars.

Description	Entity	Year 1	Year 2	Year 3	Year 4	TOTAL
Project Manager 50%, Asunción, WMO-ROA	WMO	65,000	65,000	65,000	34,650	229,650
Technical Coordinator 25%, Geneva	WMO	65,000	65,000	65,000	42,750	237,750
Project Support, Chile	DMC	5,000	5,000	5,000	5,000	20,000
Project Support, Colombia	IDEAM	5,000	5,000	5,000	5,000	20,000
Project Support, Peru	SENAMHI	5,000	5,000	5,000	5,000	20,000
Project Support, CIIFEN/RCC-WSA	CIIFEN	5,000	5,000	5,000	5,000	20,000
Inception Workshop(s)	WMO	50,000	0	0	0	50,000
Travel, missions	WMO	10,000	8,000	8,000	6,600	32,600
Office Supplies (Furniture, Equipment, Software)	WMO	6,000	2,000	2,000	0	10,000
M & E	WMO	0	5,000	0	5,000	10,000
TOTALS		216,000	165,000	160,000	109,000	650,000

Table 21. Breakdown of the Implementing Entity (WMO) fee. All amounts expressed in US dollars.

Activity	Description	Amount (USD)
Oversight/management of project implementation	Project coordination: project planning, day to day project management and implementation.	200,000
Financial Issues	Financial management practices complying with AF requirements; ensuring financial reporting; efficient procurement processes. Estimated bank fees for transfer of funds and other transactions.	230,000
Project Staff Functions, EEB Meetings	Technical support in risk management. Support to EEB meetings.	152,250
TOTAL	(8.5 % of Project Execution Cost)	582,250

24 Disbursement Schedule (H)

Table 22. Disbursement schedule for requested funds, per project year and outcome output. All amounts in US dollars.

	Upon Agreement and Contract Signing	**One year after Project start, and upon approval of Year 1 Report**	**Two years after Project start, and upon approval of Year 2 Report**	**Three years after Project start, and upon approval of Year 3 Report**	**TOTAL Funds Disbursed (USD)**
Scheduled date	November 2019	November 2020	November 2021	November 2022	
TOTAL Direct costs	1,860,000	1,860,000	1,860,000	620,000	6,200,000
Execution costs	195,000	195,000	195,000	65,000	650,000
WMO Fee (8.5%)	174,600	174,600	174,600	58,450	582,250
TOTAL Activities	2,229,600	2,229,600	2,229,600	743,450	7,432,250

PART IV: ENDORSEMENT BY GOVERNMENTS AND CERTIFICATION BY THE IMPLEMENTING ENTITY

25 Record of Endorsement on behalf of the Governments (A)

(Enter Name, Position, Ministry)	Date*: (Month, day, year)*
(Enter Name, Position, Ministry)	Date*: (Month, day, year)*
(Enter Name, Position, Ministry)	Date*: (Month, day, year)*

26 Implementing Entity Certification (B)

I certify that this proposal has been prepared in accordance with guidelines provided by the Adaptation Fund Board, and prevailing National Development and Adaptation Plans (……list here…..) and subject to the approval by the Adaptation Fund Board, commit to implementing the project/programme in compliance with the Environmental and Social Policy of the Adaptation Fund and on the understanding that the Implementing Entity will be fully (legally and financially) responsible for the implementation of this project/programme.	
Name & Signature Implementing Entity Coordinator	
Date: *(Month, Day, Year)*	Tel. and email:
Project Contact Person:	
Tel. And Email:	

ANNEX DOCUMENTS

Annex Number	Title
Annex 1.	References Cited.
Annex 2.	Consistency of ENANDES with National Plans and Strategies AND Compliance with National Standards and Environmental and Social Policy of the Adaptation Fund.
Annex 3.	Environmental and Social Impact Assessment (ESIA) and Environmental and Social Risk Management Plan (ESMRP) for Project ENANDES (Chile, Colombia and Peru).
Annex 4.	Consultations with stakeholders.
Annex 5.	WMO Checklist of NMHS Capabilities for Climate Services Implementation.

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Annex 2.

Consistency of ENANDES with National Plans and Strategies AND Compliance with National Standards and Environmental and Social Policy of the Adaptation Fund

This Annex contains the tables discussed in sections 9 and 10 of the proposal text.

Table A-1. Consistency of ENANDES with National Plans, Strategies, National Standards and Social Policy of the Adaptation Fund for Chile.

Category of Information	Regulatory framework	Relationship between these document/regulation frameworks/ technical standards and the project
National, subnational and sectorial climate change policies/ plans/	Climate Change National Action Plan (PANCC-2017-2022)	The ENANDES Concept Note identified that "climate change impacts have projected significant reduction of monthly average flows in the regions of Coquimbo and Los Lagos (intervention zone in Quillota), and an elevation of the isotherm of 0°C, which brings as a consequence the reduction of water reserves in the headwaters of the snow melting and rainwater basins, increasing the risk of disasters during extreme rainfall events and high temperatures, consequently floods and alluviums may be generated". Regarding the strategic focus of the PANCC it has the objective of articulating a crosscutting climate policy in Chile by establishing a guiding framework for all of the stakeholders. To this effect, the PANCC has 10 guiding principles, namely: - Common welfare - Equity - Sustainability - Precautionary - Transparency - Citizen participation - Cooperation and synergies - Cost effectiveness - Flexibility - Coherence One of these principles is particularly relevant considering the scope of ENANDES and the Adaptation Fund Policies (Social and Environmental Policy and Gender Policy): in terms of equity, the PANCC establishes that measures have to be for the benefit of all, particularly for vulnerable communities, sectors and ecosystems. Likewise, it highlights the relevance of paying special attention to gender equity, human rights and ethnicity. This guiding principle of the PANCC is

Category of Information	Regulatory framework	Relationship between these document/regulation frameworks/ technical standards and the project
		clearly aligned with AF Principles 2 (access & equity), 3 (vulnerable groups), 4 (human rights), 5 (gender) and 7 (indigenous peoples).
	Climate Change Adaptation Plan	From the Climate Change Adaptation Plan, changes in climate conditions in Chile are expected to increase erosion processes both in magnitude and extension, affecting the ENANDES pilot area. Significant flow reductions are expected or the Aconcagua River, leading to more frequent water scarcity. This situation will strongly affect rural communities whose livelihoods are highly dependent on agriculture and livestock.The ENANDES pilot area is Quillota, a province located in the Aconcagua Basin. Components 1-3 will address climate information production, dissemination and use in this area, emphasizing agriculture and water sectors and their interdependences.
	Agriculture Sectorial Plan	The agroforestry sectorial plan includes climate change effects on soil, production, annual and perennial crops (fruit trees), forest and pastures. The plan concludes that there will be low availability of water for irrigation, where droughts, frosts and precipitation are the main risks for the sector. The project proposal for agriculture aims to increase farmers' resilience and capacity to cope with climate change by improving climate products and services for decision-making on risk management process.
	National Strategic Plan for Disaster Risk Reduction and NDC.	The National Strategic Plan for Disaster Risk Management is the instrument to reach the objectives set by the current national DRM policy. The project aims to strengthen early warning systems and the development of scientific capabilities on identification process for risk scenarios.
	National Plan to Fight Desertification	The National Action Plan addresses drought and desertification in Chile (PANCD-Chile) and aims to reduce their negative impacts and achieve economic and social development. The Plan seeks to enhance knowledge about the causes and impacts of these phenomena and to foster development of sustainable production systems. The main objective of the project is to support the rainfed agricultural activities of the most vulnerable communities.
	Energy Agenda	Chile's energy agenda contains an action plan to build and execute a long-term energy policy with social, technical and political validation. This document has seven axes focused on reaching energetic efficiency and hydroelectric sustainability, and to conduct massive educational campaigns. All these issues are related to ENANDES Components 1, 2 and 3.
	National Strategy of Water Resources and Water Code	In the agroforestry sector a southward migration of cropped areas is anticipated as a consequence of lower availability of water for irrigation in the central zone. This shift is expected to cause negative changes in productivity and in farmers' incomes, particularly for rainfed farms and cattle ranches in the coastal, internal and transversal valleys. The energy sector will suffer the impacts of expected decreases in river flows that will limit hydroelectric generation and reduce the capacity of responding to an increasing energy demand. Finally, as ENANDES will develop activities related to water resources (particularly In Component 3), activities should observe the Water Code, particularly in terms of groundwater, water use rights, and irrigation works.
National regulatory		ILO Convention 169 was enacted by the Chilean Ministry of Foreign Affairs through Supreme Decree 236/2008, and it was ratified on September 2008. Therefore, the ILO Convention came into force in Chile on September 2009 as an

Category of Information	Regulatory framework	Relationship between these document/regulation frameworks/ technical standards and the project
framework for involvement and consultations engagement of women, elder, poor and vulnerable communities	ILO Convention 169 Supreme Decree 236/2008 Law 19.253 Supreme Decree 124/2009	international treaty on fundamental rights. In particular, Articles 6 and 7 (about consultation and participation, respectively) were declared by the Constitutional Court as "self-executing norms", meaning that they are in force since September 2009 even without any additional concrete and specific regulatory measures. Law 19.253 establishes norms about the protection and development of indigenous peoples in Chile, and it creates the *National Corporation for Indigenous Development*. Article 34 of this Law regulates indigenous participation, making it mandatory to consult indigenous peoples on matters that are directly related to them. Additionally, Supreme Decree 124/2009 regulates the above-mentioned Article 34 of Law 19.253 regarding consultation and participation processes for indigenous peoples. The legitimacy of this norm, however, has been strongly questioned by indigenous peoples themselves, given the absence of their participation in the definition of a regulatory framework that directly concerns them. Notwithstanding the foregoing, this is the national regulatory framework for involvement and consultations of indigenous peoples in Chile. Therefore, should the ENANDES project design and implement any activities in indigenous territories or directly affecting (either in a positive or negative way) indigenous peoples, it should follow these regulations: regardless of whether or not a formal consultation process should be carried out, the responsible of the project (Implementing and executing entities) should seek the effective participation of indigenous communities in the design and implementation of the USP´s of the ENANDES project as well as determine potential impacts. The design of the activities should include the participation of legal representatives or the traditional indigenous leaders, and the form and procedure in which the representatives of the indigenous communities are consulted/ engaged in the elaboration of the project´s activities must be transparent and well documented. This is particularly relevant for Component 3, in which activities may be redesigned during project implementation.
Relevant National, subnational and sectorial regulatory framework for data management, access, competencies regarding climate information and services	Law 19.300 (Bases Generales del Medio Ambiente)	The Chilean national regulatory framework for the environment is provided by Law 19.300 (*Bases Generales del Medio Ambiente*). Article 10 of Law 19.300 describes which projects or activities must undergo an environmental impact assessment. Overall, the activities listed on Article 10 are related to: Mining projects; Manufacturing facilities; Nuclear reactors and related facilities; Power generating plants greater than 3 MW; Ports, navigation routes, shipyards and maritime terminals; High voltage electric transmission lines and their substations; Airports, bus terminals, trucks and railways, railways and other road infrastructures that may affect protected areas; Agroindustries and forestry developments of industrial dimensions; Execution of works, programs or activities in areas placed under official protection;

Category of Information	Regulatory framework	Relationship between these document/regulation frameworks/ technical standards and the project
		Intensive exploitation, cultivation, and processing plants of hydrobiological resources; Activities involving toxic, explosive, radioactive, flammable, corrosive or reactive substances. Oil pipelines, gas pipelines, mining pipelines or other similar; Aqueducts and similar water infrastructure that must undergo the authorization established in article 294 of the Code of Waters, as well as dams, drainage, desiccation or dredging, activities causing significant alteration of natural water courses. Environmental sanitation projects (such as sewage and potable water systems, treatment plants and landfills); Massive application of chemical products in urban areas or rural areas close to population centers or watercourses that may be affected. Given the objective of the ENANDES project, its components, outcomes, outputs and activities, and following on the above-mentioned Article 10 of Law 19.300, this project does not require to submit to the environmental impact assessment system given by Chilean environmental regulatory framework[1]
	Law 17.375 and Law 20.285	Given that ENANDES will produce climate and meteorological information with the participation of State entities, the regulatory framework on public information must be considered. In this regard, Law 20.285 regulates the principle of transparency of the public function, the right of access to information by State institutions, and exceptions to the public nature of the information. In addition, Law 17.375 refers to the kind of information that should be preserved under "statistical secret."
	Law 16.752 Law 17.931 Organic and operational governing document-DMC Law 20.096	The National Executing Entity for the ENANDES Project in Chile is the Chilean Meteorological Directorate (DMC), which is part of the General Directorate for Civilian Aeronautics (DGAC). According to Law 16.752 the DGAC has the responsibility to install, maintain and operate meteorological services to support air traffic and other national activities. In addition to that, Law 17.931 creates the National Meteorological Data Bank (managed by the DMC), whose function will be the collection and dissemination of all national meteorological information. Also by Law 17.931 all fiscal, semi-fiscal, municipal and private bodies and institutions, as well as the autonomous services and state companies, the universities and scientific education institutes, are mandated to provide the National Meteorological Data Bank with the meteorological information obtained in compliance with their specific functions. Moreover, the organic and operational governing document of the DMC establishes that this entity's main functions are: to provide climate and meteorological services for the different socio-economic activities that the country needs for its development, to conduct meteorological research in coordination with other national and international organisms, and to administrate the National Meteorological Data Bank. Finally, Law 20.096 says that all private and public organisms measuring ultraviolet radiation will deliver such information to the DMC for its dissemination.

[1] Nevertheless, the ENANDES project will go through an Environmental and Social Impact Assessment, in compliance with the Adaptation Fund Environmental and Social Policy.

Category of Information	Regulatory framework	Relationship between these document/regulation frameworks/ technical standards and the project
	Decree with force of Law 4/20.018 (*Ley General de Servicios Eléctricos*)	Regarding planning of energy transmission, Art. 87 states that annually the National Commission of Energy has to undergo a planning process identifying, amongst others, how to minimize supply risks by taking into account eventualities such as natural disasters and extreme hydrological conditions. ENANDES intends to develop prototype systems to produce forecasts of climate-related risks to the energy sector.
	Law 20.417 Climate Change National Action Plan (PANCC-2017-2022)	In 2010 the Chilean Ministry of Environment was created by means of Law 20.417. The functions of this Ministry include proposing policies and formulating plans and programs on climate change. Article 71 of Law 20.417 creates the Ministerial Council on Sustainability, chaired by the Ministry of Environment and with the participation of other sectoral ministries such as Agriculture and Energy. From 2014 on, this Council decided to be renamed as Ministerial Council on Sustainability and Climate Change, recognizing the interdisciplinary nature of climate change. According to the Climate Change National Action Plan, the Ministerial Council on Sustainability and Climate Change leads the climate change institutional arrangements in Chile. Within this framework, there are both sectoral and territorial approaches. Regarding the latter, the PANCC creates the Regional Committees on Climate Change, aimed at promoting climate change management in regional public policies and looking for linkages and synergies between national and regional processes on climate change. So far, some of the key stakeholders identified for the ENANDES project in the National Level in Chile are the Ministry of Agriculture and the Ministry of Energy. However, the role of the Ministry of Environment is not completely clear, either at the national or regional level. Likewise, considering the climate change institutional arrangements established by the PANCC, it would be useful for ENANDES to have a clearer perspective on how this project aligns with such institutional framework.

Table A-2. Consistency of ENANDES with National Plans, Strategies, National Standards and Social Policy of the Adaptation Fund for Colombia.

Category of Information	Regulatory framework	Relationship between these document/ regulation frameworks/ technical standards and the project
National, subnational and sectoral climate change policies/ plans	National Development Plan 2010-2014	The PND 2010-2014 sets out Colombian institutional architecture to tackle climate change having as starting point the CONPES 3700 of 2011. The four strategies include: (i) the Implementation of a "National Climate Change Adaptation Plan"- PNACC; (ii) a "Financial Protection Strategy against Climate-related Disasters"; (iii) the "Colombian Strategy for Low Carbon Development (ECDBC) and (iv) within that the "National Strategy for Reducing Emissions from Deforestation (ENREDD+)". The goals of this project are closely related with the objectives of the adaptation strategy (as described below). Furthermore, the 2010-2014 PND also tasks the National Climate Change System (SISCLIMA) with the implementation of national policies on climate change; SISCLIMA was established by DECREE 298 – 24 February 2016 and has the purpose of coordinating, articulating and evaluating policies, legislation, strategies, programs, plans and projects on adaptation and mitigation. As part of this Institutional design there is an information committee led by IDEAM whose purpose is to coordinate actions related to the

		production, communication and management of technical and scientific information as input of the processes and decision making for the management of the climate change. Therefore, ENANDES objectives are aligned with the Colombian institutional arrangements and with the mandated the role of IDEAM in the production and coordination of climate related information.
	Basis for the National Development Plan 2018-2022	Currently the draft law for the 2018-2022 National Development Plan "Pacto por Colombia, Pacto por la equidad" reached Congress on 7 May 2019. In the meantime, the document Basis for the National Development Plan 2018-2022 is available (DNP, 2019) and it is clear that ENANDES is consistent with the national rationale regarding climate change. Within the framework of the transversal bases of the national development plan is Chapter IV "to produce conserving and to preserve producing". The strategy "Resilient Colombia: knowledge and prevention for the management of disaster risk and adaptation to climate change" is contemplated. The strategy discusses systems of monitoring hydroclimatic phenomena as well as EWSs. However, the strategy also acknowledged the need to orient efforts towards the study of climatic variability, with an emphasis on the study of the threats. The PND identifies IDEAM as the entity responsible, together with the DNP and Minambiente, for the design and implementation of a climate change information system. The PND states that the MinAmbiente and the UNGRD must design a national strategy with a specific focus on strengthening the communities' capacities for risk management and adaptation to climate change. Therefore, it is possible to conclude that the ENANDES project is aligned with Colombia`s PND and that it will significantly contribute to the Plan's successful implementation.
	Nationally Determined contributions.	The Ministry of Environment and Sustainable Development (MINAMBIENTE) has led since 2014 the process of preparation and discussion of Colombia's the Nationally Developed Contributions officially presented to the UNFCCC in September 2015. There, the adaptation component of the NDCs was defined in line with the country's progress through the PNACC. Ten specific actions to be achieved by 2030 were defined with the goal of moving towards economies, societies and ecosystems that are resilient to climate change impacts (Minambiente, 2015). Among these actions the following two are tightly related with the objectives of the ENANDES project: - Six priority sectors of the economy (transport, energy, agriculture, housing, health, and trade, tourism and industry) will include climate change considerations in their planning instruments and will be implementing innovative adaptation actions. - Fifteen of the country's departments will participate in the Mesas Técnicas Agroclimáticas, and 1 million producers will receive agro climatic information to facilitate decision-making in agricultural activities. Therefore, it is possible to conclude that ENANDES is aligned with the adaptation component of Colombia´s NDCs and that the project will contribute to the successful implementation of specific NDCs.

	Law 1931 in 2018. National climate change law.	The Colombian Congress passed Law 1931 on July 27, 2018. This law sets guidelines for the management of climate change in Colombia. Among the parts of this law most closely related with the ENANDES project is the creation of an information system on climate change within the framework of the Environmental Information System for Colombia –SIAC. The SIAC will provide data and information transparent and consistent in time to inform decisions related to the management of climate change.It is possible to conclude that, in addition to being aligned with the main objectives of the climate change law, ENANDES could contribute to articulate the implementation of an NFCS as part of the design of an information system on climate change. The Colombian government will issue the regulation applicable to the Law within a maximum term of three years.
	National climate change policy	MINAMBIENTE launched in 2017 the National Climate Change Policy (PNCC) with the objective of incorporating climate change management into public and private decisions to advance a climate-resilient and low-carbon development path that reduces the risks of climate change and to take advantage of the opportunities it generates (Ministerio de Ambiente y Desarrollo Sostenible, 2017). Within the instrumental lines that will allow the implementation of this policy, the law states that a national information strategy should be formulated, focused on generation and the use of the information required to foster the management of climate change. The strategy should define methodologies and institutional actors tasked with the collection, processing, and use of information related to hydroclimatic variables. Thus, the activities of ENANDES are consistent with Colombia's PNCC. Furthermore and additional to the instrumental line related with information in this policy, the Law states that it is essential to adopt an integrative perspective of the territory which jointly assesses sectoral development initiatives, as a basis for achieving successful and effective climate change management. To this end, among the actions to be implemented in the PNCC in relation to the target sectors of the ENANDES project (water, energy, agriculture), emphasis is placed on the generation and dissemination of climate information.
	Resolution 40807 of 2018 of the Ministry of Mines and Energy.	The Climate Change Management Plan for the energy and mining sector- PIGCCme was adopted through Resolution 40807 of 2018 of the Ministry of Mines and Energy. The Plan´s objective is to reduce vulnerability to climate change and promote low-carbon development at sectoral level, strengthening and protecting the sustainability and competitiveness of the mining-energy industry (Ministerio de Minas y Energia , 2019). The objective of the ENANDES project is aligned with the PICCme since It seeks to incorporate climate risk management at decision levels in the energy mining sector, in order to reduce the impacts generated by climate change and climatic variability on the mining, hydrocarbon and electric industries. Furthermore, the adaptation component of the PICCme comprehends 2 out of 4 strategies that are tightly related with the ENANDES project (i) short and long term planning and ii) information for adaptation). Thus, is possible to conclude that there is an enabling environment to articulate the expected results of the ENANDES project with the implementation of the PIGCCme.

	Climate change plan for the agriculture sector.	According to the institutional framework of Colombia´s National Framework of Climate Services, NFCS (Rojas & Cadena, 2018), an Integrative Climate Change Management Plan for the Agricultural Sector (PIGCC-AG) is being formulated. The Plan is expected to be part of the implementation of the NFCS; furthermore, it should be a strategic line or articulating instrument for the development and adaptation of the agricultural sector to climate variability and change. Additionally, representatives from the agricultural sector also mentioned alignment of the project with the following instruments: Social ordering of property. Resolution 261 of 2018 about expansion of the agricultural frontier (promoting the consideration of climate change in the planning of rural agricultural land areas), and Resolution 128 of 2017 that adopts the policy of territorial management for agricultural uses both highlight climate services as an important component.
	Local climate change plan for the Cauca Department -PICC Cauca	ENANDES has chosen the Popayán Municipality in the Department of Cauca as one of its pilot adaptation areas. This Department has a local Climate Change Plan (Ministerio de Ambiente y Desarrollo Sostenible, 2016) where one component of the plan is related with structuring a comprehensive information system for decision making related to climate change for the Department. In this sense, the actions proposed by ENANDES are directly aligned with the PICC Cauca. Consultations identified the needs (i) to produce and disseminate information about the climate, (ii) to generate user-friendly information systems that support the decision making process, and (iii) to strengthen capabilities to analyze climate data and information.
	Licensing and environmental authorizations	The Project's Environmental and Social Management Plan does not require inclusion of measures for managing risks or impacts associated with this regulation. Environmental licensing is the Colombian technical standard (administrative instrument) through which the environmental authority defines and authorizes requirements related to the prevention, mitigation, correction, compensation and management of the negative impacts of a project or activity. Decree 2820 of 5 August 2010 of the MAVDT (Ministry of Environment, Housing and Territorial Development) defines which projects require an environmental license and identifies the authorities to grant the license. Articles 7, 8 and 9 of the aforementioned decree establish the type of projects subject to environmental licensing. The activities envisioned by ENANDES do not fall into any of the categories described in the current regulation thus, this technical standard does not apply to the context of the project. Nevertheless, it is recommended for activities that are not yet defined, this technical standard should be consulted to confirm whether or not this requirement is needed. It is worth mentioning that it is unlikely that new project activities of the ENANDES project will fall into these categories, as they mainly cover infrastructure activities, energy and mining, among other activities with high environmental impacts. The activities that could eventually be related are those that involve intervention in protected areas and that are not within the framework of their management plan.
National regulatory framework for	Prior Consultation	The Project's Environmental and Social Management Plan does require the inclusion of measures to manage risks or impacts associated with this regulation.

involvement and consultations engagement of women, elder, poor and vulnerable communities		The National Constitution of Colombia establishes that cultural diversity must be respected. Through Law 21 of 1991, Colombia adopted Convention 169 of Indigenous and Tribal Peoples; for this reason, when a project is to be carried out in indigenous reserves or in territories of black communities, the prior consultation regulated in Decree 1320 of 1998 of the Ministry of the Interior must be carried out. Presidential Directive No. 1 of March 2010 determines the mechanisms for the application of Law 21 of 1991, indicates the actions that require the guarantee of the right to Prior Consultation and establishes the mechanisms through which the Prior Consultation proceeds. According to Art .1 of Decree 1320 of 1998, the purpose of the prior consultation is to analyze the economic, environmental, social and cultural impacts that may be caused to indigenous or Afro-Colombian communities by the exploitation of natural resources within their territory. According to the same decree, prior consultation applies to projects that require environmental licensing, establishment of environmental management plans or permission to use, use or affect renewable natural resources and so far the project do not include these kind of activities. Nevertheless, activities of ENANDES Component 3 are still in discussion with national executing entities. These activities include implement, monitor and asses pilot actions to increase resilience to extreme weather hazards and climate variability at targeted areas. Therefore, for those measures of component 3 that are not fully identified the responsible for the project, work or activity must verify the need to carry out the prior consultation process. Likewise, regardless of whether or not a formal consultation process should be carried out, the responsible of the project (Implementing and executing entities) should seek the participation of the indigenous communities In the design of the USP´s of the project as well as determine potential affectations. The elaboration of the activities should count with the participation of the legal representatives or the traditional indigenous leaders, and the form and procedure in which the representatives of the indigenous communities were consulted/ engaged in the elaboration of the project´s activities must be transparent and well documented. A measure identify to ensure that the project compliance with this regulation Is that as a responsibility of the Project Director, at the start of the Project, there will be consultation, with the corresponding authority of the Ministry of Interior, regarding the applicability of the requirement for activities defined under component 3.
	UN Declaration of the rights of peasants and other people working in rural Areas	At September 2018 , was adopted the UN declaration of the rights of peasants and other people working in rural Areas a fundamental step towards addressing discrimination and re-emphasizing the obligation of the state in this international norm in order to o protect peasants and rural workers from on-going systematic discrimination. Thus, at the consultation process indigenous and peasant communities were aware of this declaration and suggested to have in to account as an international reference for the project.
Relevant National, subnational and sectoral regulatory framework for data generation,	National Framework for Climate Services - NFCS	The NFCS is the initiative within this project is framed. For the case of Colombia, the initiative led by IDEAM in collaboration with the productive sectors of the country, has the purpose of providing mechanisms for coordination and collaboration, allowing a permanent and continuous dialogue in the identification and prioritization of the needs for the provision of climate services required by decision makers in different

management, access, and climate information and services		contexts at the national level, and the establishment of a coherent value chain for the co-production and application of climate services (Rojas & Cadena, 2018)
	Law 99/1993	According to the Law 99/1993 (Congreso de Colombia, 1993) by which the Ministry of the Environment is created, the Public Sector is responsible for the management and conservation of the environment is reorganized an renewable natural resources, The National Environmental System or SINA is organized. As part of SINA, the IDEAM is tasked to obtain, analyze, study, process and disseminate basic information on hydrology, hydrogeology, meteorology, and is given the responsibility for the establishment and operation of national meteorological and hydrological infrastructures to provide information, predictions, warnings and advisory services to the community and support to the environmental authorities in decision-making. Although this law does not explicitly mention the provision of climate services as defined today, the orientation of the national environmental research system and IDEAM itself, and its designated tasks, correspond to the structure and purpose currently given to climate services (Rojas & Cadena, 2018)

Table A-3. Consistency of ENANDES with National Plans, Strategies, National Standards and Social Policy of the Adaptation Fund for Peru.

Category of Information	Regulatory framework	Relationship between these document/ regulation frameworks/ technical standards and the project
National, subnational and sectorial climate change policies/ plans/	Framework Law on Climate Change Nº 30754	This Law aims to establish the principles, approaches and general provisions to coordinate, articulate, design, execute, report, monitor, evaluate and disseminate public policies for the integral, participatory and transparent management of adaptation and mitigation measures to climate change, in order to reduce the country's vulnerability to climate change.
	Final Report of the Multi-sectorial Workgroup for the National Determined Contributions (GTM-NDC)	This is the final report of the Workgroup responsible for identifying an articulated and participative approach to the mitigation and adaptation measures that Peru is committed to implement to comply with the Paris Agreement.
	Action Plan on Gender and Climate Change Supreme Decree Nº 012-2016-MINAM	The Plan of Action on Gender and Climate Change of Peru (PAGCC-Peru) is a public management instrument that seeks to guide the actions of different entities of the Peruvian State to achieve the reduction of gender inequalities in the country - within the framework of their competences related to the management of emissions of Greenhouse gases (GHGs) and adaptation to climate change.
	Risk Management and Climate Change Adaptation Plan for Agricultural Sector (PLANGRACC) 2012-2021 Ministerial Resolution Nº 0265-2012-AG	Public policy instrument on risk management and adaptation to climate change for the Agricultural Sector. It contains objectives and strategic actions that contribute to the reduction of vulnerability for the population directly involved in the agricultural sector. The instrument also discusses planning and investment in research and information, reduction of climate risks, preparation and response to emergencies of climatic origin, and improvement of capacities.
	Law on Water Resources Nº 29338	This Law regulates the use and integrated management of water, the actions of the State and individuals in its management as well as the assets associated with it. Article 99 of the Law of Water Resources establishes the planning instruments of the National System of Management of Water Resources (SNGRH in Spanish): • National Environmental Policy, • National Water Resources Policy and Strategy, • National Water Resources Plan, • Watershed Management Plans in the Watersheds
	National Water Resources Policy and Strategy	The PENRH (in Spanish) is a conceptual planning instrument of the National Water Resources Management System. As indicated in Article 102 of the Law on Water Resources, it encompasses a series of principles, guidelines, strategies and public instruments that define and guide the actions of the public and private sectors, to guarantee the satisfaction of the water demand and the better use of water in Peru, within the

		framework of the national environmental policy. This document defines five (5) water policy axes, each of which has a series of intervention strategies associated with it. These water policy axes are: Policy axis 1: Quantity management Policy axis 2: Quality management Policy axis 3: Opportunity management Policy axis 4: Water Culture Management Policy axis 5: Adaptation to climate change and extreme events
	National Water Resources Plan	The National Water Resources Plan (PNRH in Spanish) determines the programs of measures that comply with each of the five policy axes and intervention strategies formulated. Therefore, the purpose of the PNRH is to determine the measures of national interest established in the PENRH that allow solving the problems of water management in Peru, establishing the costs and sources of financing, as well as its implementation program. It follows from these articles that the satisfaction of the demands is the guiding thread of the PNRH.
	Law of the National Disaster Risk Management System Nº 29664 and its by-law Supreme Decree Nº 048-2011-PCM	This law creates the National System for Disaster Risk Management (Sinagerd in Spanish) as an inter-institutional, synergistic, decentralized, transversal and participatory system. The System aims to identify and reduce the risks associated with hazards, or minimize their effects, as well as avoiding the generation of new risks, and preparation and attention to disaster situations through the establishment of principles, policy guidelines, components, processes and instruments of Disaster Risk Management. The regional governments and local governments, as members of Sinagerd, formulate, approve norms and plans, evaluate, direct, organize, supervise and execute the Disaster Risk Management processes, within the scope of their competence, within the framework of the National Policy on Disaster Risk Management and the guidelines of the governing body, in accordance with the provisions of this Law and its regulations. The presidents of the regional governments and the mayors are the highest authorities responsible for the Disaster Risk Management processes within their respective areas of competence. Regional governments and local governments are the main executors of disaster risk management actions.
	National Disaster Risk Management Policy Supreme Decree Nº 111-2012-PCM	The Policy establishes that for the implementation and development of Disaster Risk Management requires four priority objectives, which allow the articulation and integration of its components and processes, within the framework of the National Disaster Risk Management System: 1. Institutionalize and develop the processes of Disaster Risk Management through the National Disaster Risk Management System. 2. Strengthen the development of capacities in all instances of the National Disaster Risk Management System, for decision-making at the three levels of government. 3. Incorporate and implement Disaster Risk Management through development planning and the prioritization of human, material and financial resources. 4. Strengthen the culture of prevention and increase resilience for sustainable development.

	National Plan on Disaster Management (PLANAGERD) 2014-2021 Supreme Decree Nº 034-2014-PCM	PLANAGERD is oriented to achieve a society resilient to the risk of disasters. The Plan establishes as a national objective to reduce the vulnerability of the population and their livelihoods given disaster risk. Concurrently with the national objective, six strategic objectives are proposed: 1. Develop the knowledge of risk 2. Avoid and reduce the risk conditions of livelihoods of the population with a territorial approach 3. Develop response capacity before emergencies and disasters 4. Strengthen the capacity for recovery physical, economic and social 5. Strengthen capacities institutions for the development of disaster risk management 6. Strengthen the participation of population and organized society for the development of a culture of prevention.
	Guidelines for the formation and operation of the National Early Warning Network and the conformation operation and strengthening of early warning systems Ministerial Resolution Nº 173-2015-PCM	The National Institute of Civil Defense (INDECI), is the entity responsible for guiding and monitoring compliance with the "Guidelines for the Establishment and Operation of the National Early Warning Network - RNAT and the Conformation, Operation and Strengthening of Alert Systems Early – SAT". The RNAT is defined as an articulated organization of level early warning systems communal, district, provincial, regional and national. It is constituted on the basis of the participation of scientific technical entities (such as SENAMHI) and universities. One of the components of the RNAT is: Knowledge and permanent and real-time surveillance of threats, which involve the activities aimed at acquiring information in real time about the threats to which a community is exposed or population. It includes the development of a systematic process, standardized and continuous for the collection of information existing data on damage statistics produced by past emergencies, generation and dissemination of knowledge of the trend of existing risks and scenarios in order to act timely in case of disaster or dangerous situation imminent.
	National Agrarian Policy Supreme Decree Nº 002-2016-MINAGRI	Main instrument of medium and long-term strategic orientation in agrarian matters. The National Agrarian Policy is compulsory by the National Government, by the Regional Governments and by the Local Governments. Establishes the following policy axes: Policy axis 1: Sustainable water and soil management Policy axis 2: Forest and wildlife development Policy axis 3: Legal security over land Policy axis 4: Irrigation infrastructure and technification Policy axis 5: Financing and agricultural insurance Policy axis 6: Agricultural innovation and technification Policy axis 7: Disaster Risk Management in the agricultural sector Policy axis 8: Capacity development Policy axis 9: Productive reconversion and diversification Policy axis 10: Market access

		Policy axis 11: Agrarian health and agri-food Safety Policy axis 12: Institutional development
	Strategic Agrarian Plan 2015-2021	It is the management instrument that defines the objectives and strategic actions of the sector in agrarian matters, in order to improve the intervention of the sector, oriented to results and impacts in favor of agricultural producers. The first prioritized trend within this Plan is the greater variability of climatic conditions
	Concerted Development Regional Plan; Strategic Institutional Plan (Regional Government of Lima and Regional Government of San Martin)	Planning and management documents at the regional level. One of the strategic objectives is to improve environmental quality and improve climate change management and risk management.
National regulatory framework for involvement and consultations engagement of women, elder, poor and vulnerable communities	Law on the right to prior consultation with indigenous people recognized in Convention 169 of the International Labor Organization (ILO) Nº 29785 and its by-law Supreme Decree Nº 001-2012-MC	This Law develops the content, principles and procedure of the right to prior consultation with indigenous or indigenous peoples regarding the legislative or administrative measures that directly affect them. It is interpreted conformity with the obligations established in Convention 169 of the Organization International Labor Organization (ILO).
	General Law of Peasant Communities Law Nº 24656 and Law of Native Communities and Agrarian Development of the Jungle Decree Law Nº 22175	The first lay declares the integral development of the Peasant Communities to be of national necessity and social and cultural interest. The State recognizes them as fundamental democratic institutions, autonomous in their organization, communal work and use of the land, as well as economically and administratively, within the framework of the Constitution, the present law and related provisions. The Decree Law establishes an agrarian structure that contributes to the integral development of the Selva and Ceja de Selva regions, so that their population reaches levels of life compatible with the dignity of the human person.
	Normative and jurisprudential compendium on the rights of indigenous peoples, peasant and native communities	First edition of the compilation of the normative regarding indigenous peoples, peasant and native communities rights.

	Ministerial Resolution Nº 0209-2013-JUS	
	Law of creation of the National Environmental Certification Service of Sustainable Investments (Senace) Nº 29968 and Law on promotion of investments for economic growth and sustainable growth Nº 30327	These laws create and modify Senace as a specialized technical public institution attached to the Ministry of the Environment. Its mission is to review and approve the more detailed Environmental Impact Studies (EIA-d) of public, private or mixed capital investment projects.
	Bosque de Zarate Reserve Zone Ministerial Resolution Nº 195-2010-MINAM; Cordillera Azul National Park Supreme Decree N° 031-2001-AG and Presidential Resolution Nº 032-2017-SERNANP	Establishes natural protected areas in the province of Huarochirí (Lima region) and in the provinces of Bellavista, Picota and San Martín (San Martín region).
Relevant National, subnational and sectorial regulatory framework for data management, access, competencies regarding climate information and services	Law of the National Service of Meteorology and Hydrology (SENAMHI) Nº 24031	According to this Law, SENAMHI is mandated to plan, organize, coordinate, regulate, direct and supervise meteorological, hydrological and related areas, through scientific research, studies and projects and the provision of services in matters of its competence.
	Regulation of Organization and Functions of SENAMHI Supreme Decree Nº 003-2016- MINAM	This regulation formalizes the organic structure of SENAMHI. It contains the general functions of SENAMHI and the specific functions of its organs and organic units. It also establishes their relationships and responsibilities.
	Budget Program 0068: Vulnerability Reduction and Emergency Response for Disasters	Expected result of the budget program: Reduction of the vulnerability of the population and their livelihoods in the face of the occurrence of hazards. Responsible entity: Presidency of the Council of Ministers. Levels of Government that participate in the execution of the budget program: National, Regional and Local Government. SENAMHI is explicitly related with the following products: Entities informed permanently and provided forecasts about the El Niño Phenomenon. Geographic areas monitored and alerted to hydrometeorological hazards. Entities with capacity building in disaster management.

	Regulation of Organization and Functions of MINEM Supreme Decree Nº 031-2007-EM and Supreme Decree Nº026-2010-EM	Creates the General Directorate of Energy Efficiency, responsible for proposing and evaluating the policy of energy efficiency and non-conventional renewable energies, promoting the formation of a culture of rational and efficient use of energy, as well as conducting energy planning. It is also responsible for proposing and issuing, as the case may be, the necessary regulations in the area of its competence.
	Crops National Plan (Agricultural Campaign 2018-2019)	Prioritizes the following six crops; cotton, rice, onion, corn, hard yellow corn and potatoes, which together represent a little more than 30.0% of the Gross Value of Agricultural Production, in order to program the area sown in the different producing areas of the country, based on mainly to a demand approach, trying to avoid with it the imbalances that could come from unexpected production surpluses, due to the lack of a successful sowing schedule and monitoring during the campaign.
	Supreme Decree Nº 007-2016-MINAGRI	Creates the Council of Hydrological Resources of the Interregional basin Chillon-Rimac-Lurin with the objective of participating in the planning, coordination and coordination of the sustainable use of water resources in their respective areas.

Annex 3. Environmental and Social Impact Assessment (ESIA), and Environment and Social Risk Management Plan (ESRMP) or the ENANDES Project (Chile. Colombia, and Peru).

1 Introduction

The ENANDES project is a regional initiative promoted by Colombia, Chile and Perú. These countries joined efforts to submit a proposal to the Adaptation Fund of the Kyoto Protocol (funding entity of the project) that aims at reducing vulnerability and increasing resilience by implementing climate-smart decision-making networks for better disaster risk, hydropower generation and agriculture management.

The project encompasses four specific sub-objectives for the targeted sectors and regions which in turn correspond to its four components. These sub-objectives include the: 1) generation of climate information, 2) tailoring/co-producing/co-designing climate information for the production of climate services through knowledge and action networks, 3) engagement and empowerment of stakeholders so they use this information in order to reduce vulnerability to climate change and variability trough implementation of adaptation actions, and 4) strengthening regional cooperation mechanisms.

The Adaptation Fund of the Kyoto Protocol, as part of the requirements for the approval of the ENANDES project, requested that an Environmental and Social Impact Assessment (ESIA) and an Environmental and Social Risk Management Plan (ESRMP) were conducted. These analyses are required in order to guarantee that the ENANDES project will promote positive social and environmental benefits and that it will avoid risks and adverse social and environmental impacts.

Both ESIA and ESRMP were carried out by TRANSFORMA, a Colombian non-profit organization that envisions and enables systemic changes towards making sustainable and regenerative development a reality. To this end, TRANSFORMA worked hand in hand with the World Meteorological Organization as the project's implementing entity of ENANDES, and National Meteorological and Hydrological Services of Colombia (IDEAM), Chile (DMC) and Peru (SENAMHI), as the executing entities in the three countries.

As mentioned in Deliverable 1 titled “An inception report highlighting tentative methodology including a detailed work plan and a stakeholder’s consultation plan”, the ESMRP is the **last step** of the methodology and it comprises the following: i) the synthesis of the screening and impact assessment, ii) the identification of the measures to avoid, minimize or mitigate potential risks, the monitoring arrangements in order to assist the follow up of the plan and the institutional arrangements, iii) the grievance mechanism and lastly iv) the methodology for new activities to identify potential environmental/social risks and safeguard measures to be developed during the implementation of the project. Thus, this document gathers the main results of this consultancy in order to present the final version of the ESIA and ESRMP as follows.

2 Synthesis of the Screening and Impact Assessment

2.1 Screening

As a result of the screening process this consultancy found that 12 out of the 15 principles do apply to the ENANDES project, and that 9 of the 12 applicable principles ought to be considered in the assessment stage. Finally, the outstanding AF Principles for the ENANDES Project identified during the consultations were principles number: 1) Compliance with Law, 2) Access and Equity, 3) Marginalized and Vulnerable Communities, 5) Gender Equity and Women Empowerment, and 6) Indigenous peoples.

Table 1. Summary of the screening process (Green/ applies, Gray/ does not apply or does not continues to next stage)

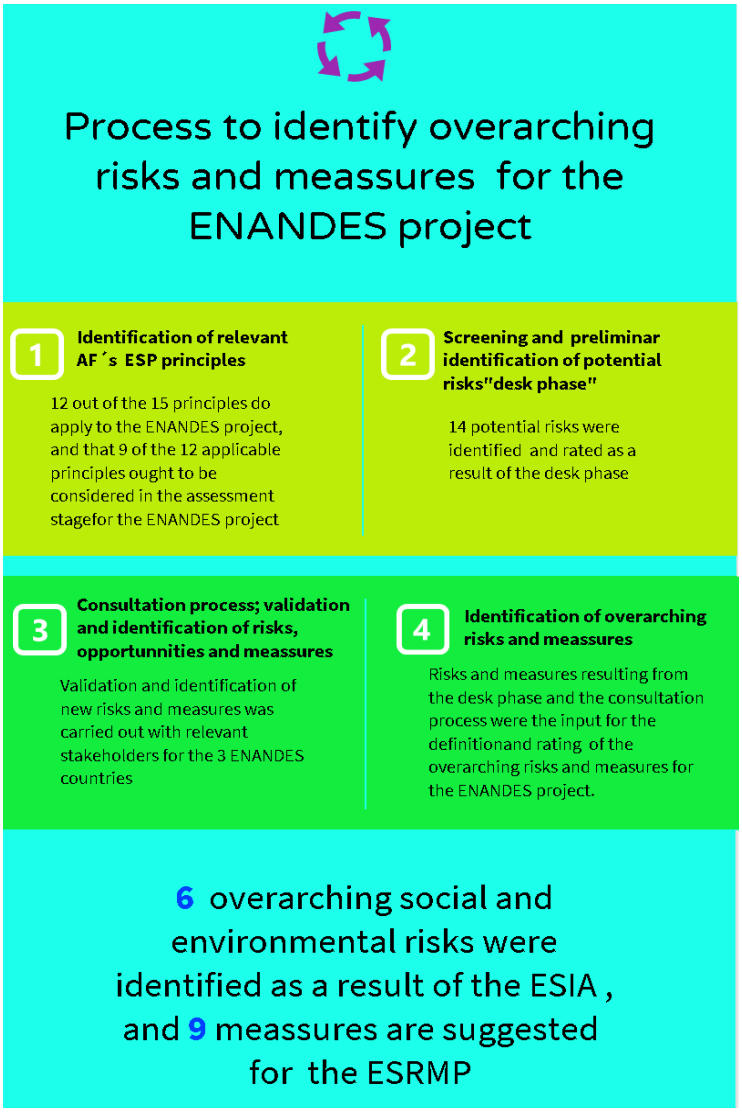
	AF Principle	Does it apply to the project?	Does it continue to the assessment stage?	Was it outstanding at the consultation process?
1	*Compliance with the Law*			
2	*Access and Equity*			
3	*Marginalized and Vulnerable Groups*			
4	*Human Rights*			
5	*Gender Equity and Women's Empowerment*			
6	*Core Labour Rights*			
7	*Indigenous Peoples*			
8	*Involuntary Resettlement*			
9	*Protection of Natural Habitats*			
10	*Conservation of Biological Diversity*			
11	*Climate Change*			
12	*Pollution Prevention and Resource Efficiency*			
13	*Public Health*			
14	*Physical and Cultural Heritage*			
15	*Lands and Soil Conservation*			

2.2 Impact assessment

The process for identifying overarching risks and measures for the ENANDES project is summarized in **Figure 1** and documented through the different deliverables of this consultancy. The following four main stages were part of this process; firstly, the identification of relevant AF principles for the context of the ENANDES project, followed by the screening and preliminary identification of potential risks at the "desk phase"[2]. Thirdly, validation and identification of new risks, opportunities and measures was carried out during the consultation process[3], and finally, risks and measures resulting from stages two and three were analyzed and integrated as the final six overarching social and environmental risks and nine measures of the ESRMP for the ENANDES project.

[2] Results of stages one and two are available in Deliverable No 2 titled: Preliminary Environmental and Social Impact Assessment ESIA.
[3] Available in Deliverable No 3 titled: "A report of the stakeholder's consultation, conducted under the development of the ESIA in the three countries of the project and first findings for the ESMRP".

Figure 1. Summary of the process to identify overarching risks for the ENANDES project.



It is important to note that results of both the desk phase and the consultation process were taken in to account when rating identified overarching risks. As a result of this process most of the identified overarching risks were considered moderate (yellow), and each of them has different levels of impact and probability of occurrence (see table 2). Likewise, these overarching risks can be differentiated between direct risks and indirect risks. For the first ones, there is enough evidence to note that the potential risks are attributable to the scope of the project, being more viable to identify a causal relationship. So, it is possible to classify the risks considering the criteria of probability of occurrence and the level of impact (see Table 2). For the case of indirect risks, there are a series of variables that come together to generate the identified risks, making it less feasible to attribute the impacts to the project in a direct causal relation. For this reason, the risks identified as indirect are not rated. Nevertheless, both for direct and indirect risks mitigation measures have been identified and suggested.

Table 2: *Overarching risks and classification*

	Overarching risks (applicable to all countries)	Level of risk[4]			Direct/ Indirect	Related Principle
		I	P	S		
1	Weak inter-institutional coordination and articulation for the project design and implementation (both amongst national institutions and between national and sub-national levels) causing weak alignment of the ENANDES project with national regulatory frameworks in Perú, Chile and Colombia.	3	4		D	Compliance with law
2	Low availability and access to climate services developed in the framework of the ENANDES project due to: 1. Availability; i) insufficient mechanisms to exchange quality information among regional, national and subnational levels. 2. Access; i) lack of context-specific communication channels to facilitate close interactions between scales, ii) unclear information /inability to bridge the gap between information developed by scientists and the practical needs of end-users..	3	4		D	Access and equity
3	Insufficient participation of key stakeholders due to i) mistrust between national and subnational actors, ii) lack of participatory platforms / mechanisms, and iii) gaps in existing mappings of key stakeholders and beneficiaries.	3	3		D	Access and equity / Marginalized and vulnerable groups
4	Lack of a clear gender perspective in the ENANDES projects as a result of it not being explicitly included in the results framework in terms of associated targets, indicators or baselines.	3	5		D	Gender and women empowerment
5	Indigenous and peasant beneficiary families not adequately informed and engaged in order to access the range of the project's benefits.	1	3		D	Indigenous peoples
6	Unexpected uses of information produced in the context of the ENANDES Project could eventually result in new or increased socio-environmental conflicts	Indirect				Access and equity / Marginalized and vulnerable groups

2.3 Overall risk classification of the project

The Environmental and Social Risk Management Plan will ensure that all risks are identified and managed, and that measures are implemented with an emphasis on risk avoidance. Additionally, it has been identified that risks at the ESMRP can be mitigated by including suggested measures in the full proposal (results framework, activities, and implementation arrangements). As a result, if the project incorporates the identified measures to mitigate social and environmental risks, it could be categorized as low risk (Category C). Nevertheless, according to the conducted risk screening and assessment (see table 2) and prior to the opportunity to implement the identified measures, identified risks are currently classified as medium, and according to the AF´s ESP the ENANDES project would be a Category B.

[4] In order to rate the magnitude of risk It is suggested the rating procedure developed by the UNDP at their Social and Environmental Safeguards was followed Procedure https://www.undp.org/content/undp/en/home/librarypage/operations1/undp-social-and-environmental-screening-procedure/. Likewise, for further information on the methodology under the consultancy, refer to Deliverable No 1: An inception report highlighting tentative methodology including a detailed work plan and a stakeholder's consultation plan

3 Identification of Measures to Avoid, Minimize or Mitigate Potential Risks. Monitoring Indicators and Institutional Arrangements.

Risk 1: Weak institutional coordination and articulation for project design and implementation (both among national institutions and between national and sub-national levels) causing weak alignment of the ENANDES project with national regulatory frameworks in Perú, Chile and Colombia.

National and local stakeholders were consulted during the project design to ensure compliance with all relevant laws and technical standards. Consultations allowed to establish that the project is aligned with international and domestic regulatory frameworks. Nevertheless, an articulation and coordination risk was identified and classified as moderate.

The **measure** identified to mitigate this risk is to formalize the project governance through the approval of the institutional arrangements by the **Project Board/steering committee** including at least: i) regional, national, subnational and local strategic partners and their roles in the project, ii) participatory and decision-making instances, iii) coordination mechanisms with existing processes related to climate change management, and iv) working agreements between stakeholders such as inter-administrative agreements (if needed) in order to ensure constant and articulated participation.

To this end, at the **National Inception Workshop** of the project that should be held for the three countries after the project document has been signed, it is highly recommended to clearly discuss and agree on the governance structure of the project and set as a **goal for the workshop the definition and mechanism to approve and validate the institutional arrangements of the project**. This, in order to discuss the roles and responsibilities of the project's team in light of the final results framework as well as the financial reporting procedures and the first-year annual work plan. Likewise, the inception report should also include details of the participation instances required for the project, the identification of coordination mechanisms with existing platforms and establishing how to formalize working agreements in the framework of the project (e.g. inter-administration agreements). Finally, in order to guaranty the legitimacy of the agreements regarding institutional arrangements of the project, participation of representatives of all relevant stakeholders must be encouraged and reflected at inception report.

Based on the results of the inception workshop, it is recommended that the regional project coordinator/manager, jointly with the national executing entities **formalizes and validates the implementation arrangements** of the project including the flow chart and terms of reference for the different project instances and roles (e.g. regional steering committee, national steering committee, regional project coordinator, among others). The formalization of the project should be agreed and jointly prepared by the WMO, the national executing entities and the regional project coordination/manager, in order to be **approved by the Project Board/steering committee.**

For this measure the following monitoring indicator is suggested:

One (1) document (inception report), as result of the inception workshop including main findings regarding roles and responsibilities, as well as the work flow charrt and the terms of reference for different project instances and roles.

Risk 2: Low availability and access to climate services developed in the framework of the ENANDES project due to: 1. Availability: i) insufficient mechanisms to exchange quality information among regional, national and subnational levels. 2. Access; i) lack of context-specific communication channels to facilitate close interactions between scales , ii) unclear information /inability to bridge the gap between information developed by scientists a and the practical needs of end-users.

During consultations the project was identified as an opportunity to integrate the national, sectorial, regional and local scales under the framework of climate services. Nevertheless, the risk of low access to information is perceived.

The **measures** identified in order to mitigate this potential risk are the following:

- Establish, socialize and agree with relevant stakeholders of the project at the regional, national, subnational and local level, clear protocols and agreements for information exchange, including, when necessary, the identification of existing gaps in information exchange and measures to overcome them (e.g. confidentiality agreements). To this end, it is suggested to produce a document with the data protocol and agreement for use and management of the information generated within the framework of the ENANDES project. Furthermore, it is recommended to socialize, validate and approve the above-mentioned document at the corresponding instance(s) of the project and since the earliest stages of implementation (e.g. regional steering committee, national steering committee, local consultation committee). This activity could be framed within component 1 of the project.
- Conduct a characterization of context-specific communication channels in order to define which means of communication are more frequently and effectively used by community stakeholders in the specific intervention area. To this end, it is suggested that the communication, knowledge management and strengthening capacity activities, (Outputs 2.4, 3.2) develops and uses as input for its design and implementation, the above-mentioned characterization.
- Ensure that climatic information produced is processed and presented to beneficiaries in a manner that is understandable and fit for purpose. Raw data, even if robust, requires processing capacity in order for it to be useful for understanding and decision making purposes. Thus, how the information is presented is critical in order to avoid information overload that may lead to beneficiaries either not using the information or using it wrongly.

For these measures the following monitoring indicators are suggested:

One (1) document containing the protocols and agreements for the use and management of the information generated within the framework of the ENANDES project. The document should contribute to the identification of gaps and good practices for exchanging information at the ENANDES project, considering context specific conditions for each of the three countries as well as processing capacity of beneficiaries in order make available useful information for beneficiaries.

Risk 3: Insufficient participation of key stakeholders due to i) mistrust between national and subnational actors, ii) lack of participatory platforms / mechanisms, and iii) gaps in existing mappings of key stakeholders and beneficiaries.

The success and sustainability of the ENANDES project requires the participation of a series of stakeholders so that the information produced in the framework of the project generates the expected levels of adaptation to climate change as well as the expected social, economic and environmental benefits. At the same time, each sector has specific information and data flow schemes composed by relevant stakeholders including beneficiaries. The stakeholders enabling the information flow is a key factor in following up on informational access and relevance. During the consultation process it became clear that there are a series of stakeholders that should be further identified and involved in the project. These are located in different contexts so the strategies to ensure their participation must consider these particularities. One of these key stakeholders are

regional and local government, who conduct their own processes of development and adaptation to climate change and are important intermediaries between national government and communities. Their commitment is necessary for the objectives of the project.

Therefore, as a **measure** to mitigate this risk of insufficient participation of key stakeholders, the project must conduct an exhaustive mapping of beneficiaries based on their main needs and uses of information (related to the Outputs 2.1 and 2.2) and on their relationship to main factors of vulnerability (related to the Activity 3.1.1). This mapping process should be developed:

- In an articulated way with key and empowered local stakeholders, for whom capacity building activities, especially for regional and local governments, needs to be strengthened (linked to the Activity 3.2.1);
- Under defined information and data flow schemes for each sector aligned to climate change adaptation commitments and development objectives. All the stakeholders involved in each data flow scheme must be included in the mapping. This information and data flow scheme can be validated in a participatory manner at the beginning of the project (this is linked to the Activities 1.1.1 and 1.2.1);
- To deepen the understanding of necessary conditions for effective participation and how they vary by context. For instance, this mapping process should include as a by-product a systematization of lessons learned from previous experiences in agro-climatic roundtables and early warning systems, as well as existing and ample relevant literature on the matter.
- To assign strategic and clear roles of involvement in the provision and in monitoring of information, so as to ensure the participation and ownership of the community in activities of the project. Roles include, for example, monitoring and exchange of information based on their traditional knowledge (linked to Output 1.3 and Activities 3.2.2, 3.3.5, 3.3.7, 3.3.8, 3.4.3 and 3.4.5).

For this measure the following monitoring indicators are suggested:

- Number of beneficiaries mappings in each country and for each sector conducted in a participatory manner,
- Number of successful capacity building programs for local stakeholders (including measures of learning and appropriation),
- Number of studies to identify favorable conditions for effective participation,,
- Percentage of tasks and activities of the project assigned and implemented in collaboration with communities.

Risk 4: Lack of a clear gender perspective in the ENANDES projects as a result of it not being explicitly included in the results framework in terms of associated targets, indicators or baselines.

Both during the desk review phase of the ESIA/ESRMP and during the consultation process in the three countries, it was identified the need to have explicit responsibilities regarding how to guarantee that the ENANDES Project effectively includes a gender perspective. In this regard, as a mitigation **measure,** it is suggested that the ENANDES Project establishes a "gender equity committee" in each of the countries, including all relevant stakeholders according to each context. Such committees will be entrusted to oversee that the ENANDES Project: i) follows the AF's GP including carrying out the **initial diverse gender assessment** and ensuring that project personnel are familiar with gender concepts such as a gender mainstreaming and diverse genders approach and its relevance in the sectors in which the adaptation intervention is taking place and how it impacts access and use of climatic information, ii) acknowledges and enables cultural, traditional and context specific roles and responsibilities in the sectors and areas of implementation, iii) identifies the various interests, needs and priorities beneficiaries of all genders including women and men, iv) equally enables the effective participation of all genders, including women and men during its implementation, v)

strengthens national and sub-national capacities to approach gender consideration in the context of climate change adaptation.

As an additional mitigation **measure**, it is recommended to create a specific framework to achieve gender mainstreaming within project implementation. In order to do this the ENANDES Project should include in the results framework some of the following considerations:

- Aim to develop and strengthen Gender-Sensitive Weather, Hydrological and Climate Services for the countries participating in ENANDES Project, building on WMO's Gender Equality Policy.
- Establish a baseline on differential situations between men and women in the specific areas and sectors of project intervention. This baseline will be key to inform how to include differential approaches in Outputs 2.1, 2.2, 2.4 and 3.3[5].
- Develop a strategy to ensure the inclusion of gender considerations in activities[6] under Outputs 3.2-3.6 and 4.2-4.3 related to: 1) gathering data about weather/climate information needs, 2) designing and implementing adaptation actions, training efforts and workshops, and 3) outreach and communication efforts.

For these measures the following monitoring indicators are suggested: number of explicit references to gender equity included in the results framework and establishment of the "Gender equity committee" for the ENANDES Project in each country. The WMO and Executing Entities in each country are responsible to establish the committees, and these committees would be responsible to further develop the gender framework and of the suggested monitoring indicators.

Risk 5: Indigenous and peasant beneficiary families not being adequately informed and engaged to access the range of project´s benefits.

The project is consistent with the rights and responsibilities set forth in the UN Declaration on the Rights of Indigenous Peoples and other applicable international instruments relating to indigenous peoples. Nevertheless, it is of great importance for the project to take into consideration indigenous groups and peasant communities present at the pilot areas. During the consultation process it was identified that the involvement of indigenous communities in climate services at the pilot areas of the ENANDES project will have the potential for scaling up community based adaptation solutions.

The following **measure** was identified in order to materialize the above-mentioned opportunity and avoid the risk of not having engagement of indigenous peoples: to document evidences, lessons learned and good practices of consultations to the rural communities with which the project is going to develop activities.

To this end, legitimate participation platforms of rural (peasant) and indigenous communities involved with activities of the project should be identified. Also, activities within components 2 and 3 with regard to rural communities should be jointly developed and adopted with rural communities. As evidence, support meeting minutes should be developed after every meeting with local actors. Furthermore, the communication, knowledge management and strengthening capacity activities, (Outputs 2.4, 3.2), as well as the participatory processes in the co-design of adaptation activities (Output 3.3) shall include the ideas and needs of indigenous groups and peasant communities, including different understandings of the environment, the various elements of the ecosystems and the nature of the relationship between humans and the environment.

Finally, and in order to potentiate the opportunity of working with rural communities, it is advisable for the project to include among its activities the generation of a document gathering good practices and lessons

[5] Particularly for Activities 2.1.2, 2.2.1, 2.4.1., 2.4.2 and 3.3.5.
[6] Particularly Activities 3.2.1-3.2.4, 3.3.1-3.3.4, 3.4.5, 3.5.1, 3.6.1, 4.2.2, 4.3.2, and 4.3.3

learned from indigenous and peasant communities at the co-design of climate change activities within the framework of national climate services.

For this measure the following monitoring indicators are suggested:

- Number of meetings held for consultations to the rural communities with which the project is designing/developing activities.
- One (1) document with good participation practices and lessons learned from indigenous and peasant communities at co-design of climate change activities within the framework of national climate services.

Note and disclaimer: During the consultation process in Colombia, local implementing partners and community actors, which included indigenous peoples and peasants, stressed that the ENANDES project would not need prior consultation as it would be developed within the framework of legitimate local participation platforms aligned with local planning mechanisms of indigenous and peasant communities - Nevertheless, activities of component 3 of the project are still under discussion with national executing entities and pilot areas of ENANDES countries and are not yet fully identified and could include as beneficiaries indigenous populations. These activities include the implementation, monitoring and assessment of pilot actions to increase resilience to extreme weather hazards and climate variability at targeted areas. Therefore, for those measures of component 3 that are not fully identified the need for prior consultation must be re-assessed under the implementation of ENANDES once the projects, work or activities are established.

Likewise, regardless of whether or not a formal prior consultation process should be carried out, those responsible for the implementation of the project (implementing and executing entities) should seek the participation of the indigenous communities in the design of new activities of the project as well as to determine potential impacts. The elaboration of the activities should include participation of the legitimate representatives or the traditional indigenous leaders, and the way and procedure in which the representatives of the indigenous communities are consulted/ engaged in the elaboration of the project´s activities must be transparent and well documented.

Finally, it is important to highlight that this conclusion stems from the assessment carried out for the ESIA and ESRMP including the above mentioned consultations, but it is not of the competence of TRANSFORMA in the framework of this consultancy to determine with legal accuracy the need for prior consultation. This must be adequately assessed in the context of the development of the full proposal and in close consultation with relevant national and local stakeholders.

A measure identified to ensure the project compliance with this requirement is that as a responsibility of the Project Director, there will be consultation, regarding the applicability of the requirement for new activities defined under Outcome 3.

Risk 6: Unexpected uses of information produced in the context of the ENANDES Project could eventually result in new or increased socio-environmental conflicts.

Considering that new climate information will lead to future projects/interventions with uncertain and unpredictable impacts related to the AF 15 principles, such information must be treated carefully and its dissemination, inasmuch as possible, needs to avoid causing potential damages to specific groups of population or to the environment. For example, better-informed farmers could have an unexpected impact on lands, diversity and protection of natural habitats with valuable ecosystem services so to increased economic activity. Similarly, new climate information could influence local planning processes affecting land value in climate-vulnerable areas.

Being this an indirect risk and considering that it is not possible to identify to what extent and in what ways new climate information will affect or influence future decision-making processes, potential mitigation

measures for this risk are not specific. However, in general terms, a possible way to mitigate this risk is to raise awareness of each specific context, relevant stakeholders, interests and existing conflicts in the implementation areas. Likewise, it would be important to take note of lessons learned from previous experiences on producing climate/weather information and the kind of projects and interventions developed afterwards using such information/data.

Additionally, it is important that the project evaluates the possibility of including mitigation measures to prevent these risks from occurring, as mentioned in the Activity 3.6.3 to monitor possible unintended effects and maladaptation. In this regard, it is suggested that the ENANDES Project establishes an auditing unit composed by land use planning authorities, natural protected areas authorities and regional or local authorities responsible of adaptation and GHG mitigation measures in each sector in the areas of intervention, among other relevant actors to comment and approve the climatic services to be provided within the project (all these must expand the scope of the Activity 3.3.2. and the activities included in Output 3.6). National Executing Entities will be responsible for installing the auditing unit and the auditing unit will be responsible for implementing the measure

The monitoring indicators should also be included in the baselines considered so far by the project. It is recommended that a specific baseline and monitoring system of land uses, deforestation levels, natural protected areas, soil erosion levels, and main drivers and enabling conditions for mitigation and adaptation measures would be incorporated.

Table 3. *Environmental and Social Risk Management Plan.*

	Potential risk	Mitigation measures/measure for enhancing the benefits of the project	Monitoring indicators	Responsible
1	Weak institutional coordination and articulation for project design and implementation (both among national institutions and between national and sub-national levels) causing weak alignment of the ENANDES project with national regulatory frameworks in Perú, Chile and Colombia	Formalization of the project governance including: I) Identification of regional, national, subnational and local strategic partners and their roles in project, II) establishment of participatory and decision-making instances, III) Identification of coordination mechanisms with existing processes related to climate change management, IV) identification and formalization of working agreements in order to ensure constant and articulated participation.	One (1) document (inception report), as result of the inception workshop with the including main findings regarding roles and responsibilities, as well as the organigram and the terms of reference for different project instances and roles.	Implementing Entity, National Executing Entities, Project Director,
2	Low availability and access to climate services developed in the framework of the ENANDES project due to: 1. Availability; i) insufficient mechanisms to exchange quality information among regional, national and subnational levels. 2. Access; i) lack of context-specific communication channels to facilitate close interactions between scales , ii) unclear information /inability to bridge the gap between information developed by scientists a and the practical needs of end-users..	Establish, socialize and agree with relevant stakeholders of the project at the regional, national, subnational and local level, clear protocols for information exchange, including, when necessary, the identification of existing gaps and measures to overcome them (e.g. confidentiality agreements)	One (1) document containing the protocols and agreements for use and management of the information generated within the framework of the ENANDES project. The document should contribute to the identification of gaps and good practices for exchanging information at the ENANDES project, considering context specific conditions for each of the three countries.	Project Regional Coordinator (manager) ,/ Project National coordinator (manager),/ National Executing entity
		Conduct a characterization of context specific communication channels in order to define which means of communication are more frequently and effectively used by community stakeholders in the specific intervention area. This document should serve as an input for the communication strategy of the project.	One (1) document with the characterization of context specific communication channels for each of the three countries.	
3	Insufficient participation of key stakeholders due to i) mistrust between national and subnational actors, ii) lack of participatory platforms / mechanisms, and iii) gaps in existing mappings of key stakeholders and beneficiaries.	Exhaustive mapping of beneficiaries based on their main needs and uses of information and on their relationship to main factors of vulnerability.	Number of beneficiaries mapping in each country for each sector Number of capacity building programs for local stakeholders Number of studies to identify favorable conditions for effective participation Percentage of tasks and activities assigned and implemented in collaboration with communities	Executing Entities in each country

4	Lack of a clear gender perspective in the ENANDES projects as a result of it not being explicitly included in the results framework in terms of associated targets, indicators or baselines.	Incorporation of specific gender-related activities, targets and indicators in the results framework of the ENANDES Project, following WMO Gender Equality Policy	Number of explicit references to gender equity included in the results framework	Implementing Entity and National Executing Entities
		Consolidation of a "gender equity committee" in each one of the implementing countries.	Number of "Gender equity committees" created for the ENANDES Project	
5	Indigenous and peasant beneficiary families not being adequately informed and engaged to access the range of the project´s benefits	To document evidences, lessons learned and good practices of consultations to the rural communities with which the Project is going to develop activities.	Number of meetings held for consultations to the rural communities with which the project is designing/developing activities. One (1) document with good participation practices and lessons learned from indigenous and peasant communities at co-design of climate change activities within the framework of national climate services.	Project Regional Coordinator (manager) ,/ Project National coordinator (manager),/ National Executing entity
6	Unexpected uses of information produced in the context of the ENANDES Project could eventually result in new or increased socio-environmental conflicts	To put together a baseline on previous experiences on producing weather/climate information highlighting associated stakeholders, interests and conflicts.	Number of documents relating lessons learnt from previous experiences on producing climate/weather information and the kind of projects and interventions developed afterwards using such information/data	Implementing Entity and National Executing Entities
		Installation of an auditing unit composed by land use planning authorities, natural protected areas authorities and regional or local authorities responsible of adaptation and GHG mitigation measures in each sector in the areas of intervention, among other relevant actors to comment and approve the climatic services to be provided within ENANDES project.	Baseline and monitoring system of land uses, deforestation levels, natural protected areas, soil erosion, their main drivers and the enabling conditions for mitigation and adaptation measures.	National Executing Entities

3.1 Monitoring arrangements

The indicators associated with the identified measures are suggested to be included at the results framework, activities and institutional arrangements of the project and thereby they will be also aligned with the monitoring mechanisms of the project such as the annual progress reports and midterm evaluations, among others. Therefore, these measures need to be planned as part of implementation activities, and monitoring arrangements are suggested to be submitted and approved by the Board/steering committee of the project along with frequency of monitoring and responsibilities for monitoring. Additionally, national coordinators/project managers will be responsible for oversee the measures considered in the risk management plan in order to ensure compliance with the requirements of the environmental and social assessment and management frameworks.

3.2 Institutional Arrangements

The implementation of the ESRMP is under the responsibility of Implementing and Executing entities of the ENANDES Project, namely WMO, SENAMHI, DMC and IDEAM. Additionally, support from strategic partners of the project as well as other key stakeholders may be necessary to manage some of the social and environmental risks. The table below provides information on the actor responsible for implementing the ESRMP and their respective roles.

Actor Involved	Responsibility/Role
Implementing Entity	To ensure that ENANDES Project complies, at all times, with the standards of the AF's ESP Principles. To supervise the implementation of the mitigation measures under the ESRMP.
Executing Entities	To monitor and disseminate the ESIA/ESRMP, particularly its grievance mechanism, amongst relevant stakeholders and beneficiaries. To ensure that project implementation follows national (and international) applicable regulatory frameworks. To Follow-up the implementation of the activities of the ESRMP and to assess effectiveness of mitigation measures that are put in place.
Project Manager	To lead day-to-day project implementation and regular monitoring, identifying any potential new social and/or environmental risks arising during project implementation, so that the appropriate support and mitigation measures can be timely adopted.
Project Partners	To provide feedback on the potential new social/environmental risks which could result during project implementation. To assist the implementation and monitoring of mitigation measures, according their competences.

4 Grievance mechanism

An important component of the ESRMP for the ENANDES project is the grievance mechanism. This should be understood as (i) key communication channels with the different identified stakeholders of the project, and (ii) sources of information regarding potential risks that the project could produce or anticipate. The ultimate goal is to be able to provide a rapid response, remediation or compensation if the project has had a negative effect on one of its stakeholders.

Both the WMO and each national executing entities already have their own established grievance mechanisms. The following links contain the specific grievance mechanisms for each of them:

- WMO: https://public.wmo.int/en/about-us/planning-finance-accountability/internal-oversight-office/report-fraud-corruption-or-abuse
- IDEAM: http://www.ideam.gov.co/web/atencion-y-participacion-ciudadana/contactenos
- DMC: https://www.dgac.gob.cl/oirs/
- SENAMHI: https://www.senamhi.gob.pe/?&p=libro-reclamaciones

Most mechanisms are proposed through the institutional website or in person at the national level offices. To avoid duplication, ENANDES should maintain the same institutional mechanisms and disseminate them strategically so that the different stakeholders of the project know about them and can use them if they require doing so. In addition, the ENANDES project should include in the participation spaces, for instance at the "mesas agroclimáticas", a grievance function so that local stakeholders could also share their complaint within these spaces.

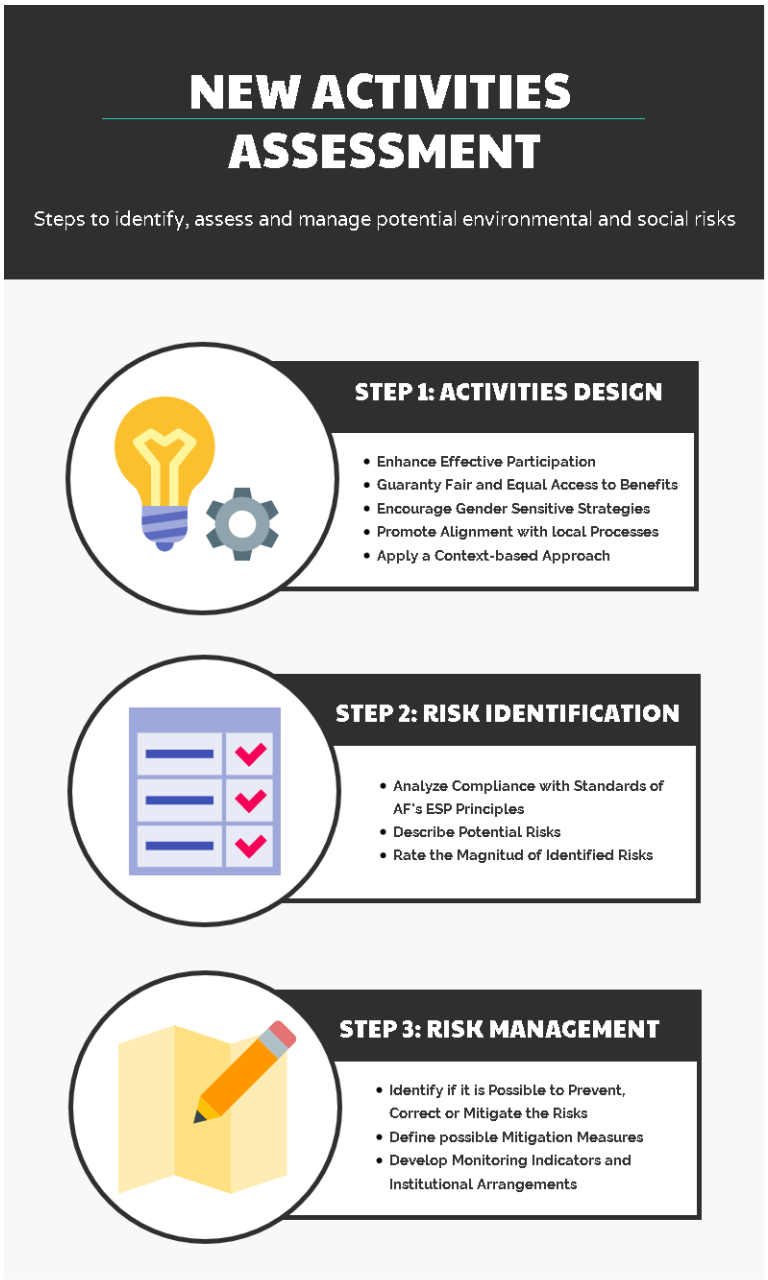
Since it was evident during the consultation process that many stakeholders do not know the information that the national executing entities produce because they do not know where they can find it; and because different stakeholders are located within the pilot areas of intervention, what ENANDES should take advantage of is to develop a good strategy for the dissemination of these mechanisms. It is then important to incorporate in the activities of communication, dissemination and participation with stakeholders a detailed explanation of what do grievance mechanisms consist of, what are their purpose and how can they access them.

For instance, it must be clear to the stakeholders that the grievance mechanisms are backed by fair and reliable processes, that they are understandable and easy to access, and that they are transparent by keeping stakeholders informed about its progress. The risks and mitigation measures already analyzed in this ESRMP are a starting point to delimit the type of risks that these grievance mechanisms would consider for evaluation and possibly remediation.

5 Methodology for New Activities to Identify Potential Environmental/Social Risks and Safeguard Measures to be Developed During Implementation of the Project.

Due to the nature of ENANDES Outcome 3 where specific intervention areas have not been fully identified and the remaining uncertainty inherent to the definition of output 3.3 - Context-appropriate preparedness and adaptation plans and actions, Annex 3.1 shows the suggested methodology for screening and risk assessment for potential new activities that can result during the implementation of the ENANDES project. The above mentioned methodology is summarized in Figure 2.

Figure 2. *Suggested methodology for screening and risk assessment for potential new activities.*



Annex 3.1: Screening and risk assessment for potential new activities

Step 1: Activities design

While designing new activities of the project, it is important as a minimum, to take in to account the following aspects:

- Actively involve local community actors and entities with direct competences in sectoral agendas, in the project implementation area.
- Gather relevant information for focalization and for allocating benefits distribution to ensure fair and equal access to benefits,
- Pursue strategies and structures to increase the involvement of women, as well as men in the development and communication of gender-sensitive weather, hydrological and climate services.
- Support the organizational processes of local communities as a platform to design new activities improving local knowledge, capacities and the effective reach and access to benefits of the project. Alignment,

Step 2: Risk identification and categorization

Once new activity(ies) have been designed, it is suggested to fill-in the following format in order to identify and assess potential risks against the outstanding AF´s ESP principles for the context of the project.

As a result of the screening process was found that the AF Principles that continued to the assessment stage for the ENANDES Project were: 1) Compliance with Law, 2) Access and Equity, 3) Marginalized and Vulnerable Communities, 5) Gender Equity and Women Empowerment, 6) Indigenous peoples, 9) Protection of Natural Habitats, 10) Conservation of Biological Diversity. Thus, this principles are the ones to be contrasted against new activities under the assumption that they will be design in a coherent logic with the four components of the project with the ultimate goal of materialize a network of knowledge in the field of climate services by implementing pilot actions to mitigate damages from, and increase resilience to extreme weather hazards and climate variability in targeted sectors and regions.

The following format was conceived based on the experience of the ENANDES project consultation process and the implementation of the methodological framework.

Relevant environmental and social principles	Evaluation Criteria	Potential associated risk	Level of risk[7]		
			I	P	S
Compliance with the Law	Which laws/standards/policies/plans do you consider should guide the implementation of the new activities? What permissions/procedures/ licenses do you think should be requested for the development of the new activities?				
Access and Equity	Who do you identify as key institutions, individuals or organizations that could participate in the implementation of new activities? What is their level of interest and influence in the ENANDES Project? Who (organizations/interest groups/communities) would you consider as beneficiaries of the new activities? Is there enough information on their expectations, needs and interests regarding the new activities? How can effective participation be ensured in the implementation of the new activities?				
Marginalized and Vulnerable Groups	Has a process been followed to identify marginalized and vulnerable groups that may be affected by the new activities? Which vulnerable/marginalized groups do you identify that may be affected by the implementation of the new activities?				
Gender Equity and Women's Empowerment	Does the new activity ensure that women and men have equitable opportunities to participate, receive equitable social and economic benefits and are not unevenly affected by potential negative impacts? Does the new activity ensure that women and men have been given equitable opportunities to participate in its implementation? Have/will women been encouraged to get actively involved in the new activity? Have the influences of gender been understood and considered in the allocation of roles between men and women for the implementation of the new activities?				

[7] In order to rate the magnitude of risk It is suggested to follow the rating procedure developed by the UNDP at their Social and Environmental Safeguards Procedure https://www.undp.org/content/undp/en/home/librarypage/operations1/undp-social-and-environmental-screening-procedure/

Relevant environmental and social principles	Evaluation Criteria	Potential associated risk	Level of risk[7]		
			I	P	S
Indigenous Peoples	Do you identify any indigenous people/group/community that may be affected (positively/negatively) by the new activities? Is there any kind of prior relationship with indigenous peoples/groups/communities in the area of intervention of the new activities? Have the affected indigenous people been involved in the new activities design, implementation and expected outcomes?				
Protection of Natural Habitats	Does new activity have the potential to negatively impact on natural habitats (either directly, indirectly and/or cumulatively)? Does the target area fall within a formally or traditionally protected area? Could the new activities potentially result in negative impacts to natural habitats and/or protected areas?				
Conservation of Biological Diversity	Does the new activity have the potential to negatively impact on biological diversity, critical biodiversity areas and/or species of special concern (either directly, indirectly and/or cumulatively)?				

Step 3: Mitigation measures, Monitoring and Institutional Arrangements

In order to identify possible mitigation measures, it is suggested to follow the proposed methodological framework for the consultation process of the ESIA/ESRMP for ENANDES Project. This will allow to have an effective participatory mechanism to identify actions to prevent, correct or mitigate negative social and/or environmental impacts of the new activities.

This step has two possible outcomes:

1) No mitigation possible: if the new activities are identified to have significant adverse environmental or social impacts that are irreversible or not possible to prevent, correct or mitigate, it is recommended no to proceed with the new activities as designed. In these cases, alternatives to the proposed activities should be considered.

2) Identify mitigation measures, monitoring and institutional arrangements to overcome the identified social and/or environmental risks. Mitigation measures should align with the results framework of the project. Indicators for the successful implementation of identified mitigation measures should be aligned with the overall monitoring and evaluation framework. Likewise, institutional arrangements should be coherent with the implementation arrangements of the project.

In order to systematize relevant findings, it is suggested to fill in the following format:

Potential risk		Mitigation measures/ measure for enhancing the benefits of the new activities	Monitoring indicators	Responsible and Institutional Arrangement
1				
2				
3				
…				

Annex 4.

Details of Stakeholder Consultations (in Spanish)

COLOMBIA (Meetings 10, 12 and 13 July 2018)

Matriz de Reporte de Consultas Nacionales
País/Ciudad/Sede del Taller/Fecha Colombia, Riosucio. Auditorio de la Cámara de Comercio. Julio 10 de 2018.
Equipo Facilitador Luis Reinaldo Barreto, IDEAM Olga Janeth Galindo Ruiz, CIIFEN
Institución Anfitriona Asohofrucol
Descripción Participantes Productores Rurales de Aguacate, Café, Plátano, Frutales de clima medio y cálido, representantes de la Asociación de Caficultores de Riosucio, funcionarios de la Alcaldía y una concejala. Todos son miembros de Asohofrucol. Nivel educativo diverso. (30 asistentes).
Hallazgos sobre qué información (productos, frecuencia, resolución) del SMHN necesitan para mejorar: la planeación del cultivo, planes de gestión de riesgos climáticos (prevención, preparación y respuesta) en su respectivo sector. Pronósticos sobre fenómenos como lluvias frecuentes o intensas, heladas, sequías, vientos, granizadas y fenómenos de El Niño y La Niña a escalas detalladas más allá de los municipios. Indicaciones sobre cómo enfrentar eventos como inundaciones y sequías.
Hallazgos sobre qué información (productos, frecuencia, resolución) del SMHN necesitan para mejorar sus planes de adaptación al cambio climático a largo plazo en su respectivo sector. Información acerca de medidas de adaptación de acuerdo a los cultivos que tiene cada usuario miembro de la asociación. Información y conceptos de predicción climática e información sobre pronósticos para el manejo de los cultivos y la probabilidad de eventos extremos. Información a escalas más detallada. Información sobre impactos económicos y productivos sobre los cultivos. Las mesas agroclimáticas regionales y el boletín que se emite mensualmente, establecen recomendaciones que deben ser difundidas hacia los agricultores de la región. Sin embargo, los participantes manifiestan la necesidad de información sobre prácticas culturales. Conocimiento sobre acciones de prevención, como siembras de acuerdo a aspectos climáticos y aspectos físicos del territorio; restauración, conservación de bosques, cuidado de los nacimientos. Manejo de medidas para el manejo de los vientos fuertes.

Hallazgos sobre cuáles son las barreras (acceso, comprensión, escasa articulación, capacitación, empoderamiento local, etc.) que impiden la aplicación de la información entregada por los SMHN para: 1) La gestión de riesgos (prevención, preparación y respuesta) y toma de decisiones en los sectores agricultura, agua y energía, y 2) Los planes y acciones locales de gestión de riesgos y adaptación.

- Sólo algunos usuarios indicaron conocer el boletín de predicción climática regional.
- La información no es de fácil acceso para todos los usuarios, deben tenerse en cuenta medios masivos de difusión diferentes al internet.
- Los boletines agroclimáticos regionales ya existentes en el departamento no están llegando a todos los usuarios.
- La información existente está aún a una escala muy regional, situación que no permite tomar decisiones a escala de su cultivo.
- La información existente está muy fragmentada, y no se tiene claridad acerca de cuál es la información oficial.
- La información que se encuentra en la página web del IDEAM no es fácil de entender, ni fácil de encontrar.

Análisis de percepciones de los actores locales:

- En general, existe mucha confusión respecto a la información climática, en cuanto a la oficialidad de la misma, y sobre los sitios y formas de consulta.
- La escala de información existente es muy amplia, lo cual dificulta la toma de decisiones frente a sus actividades productivas.
- Los asistentes en general muestran confusión respecto a los conceptos básicos.
- Para los usuarios, no es muy clara la información generada por el IDEAM, y en algunos casos, le atribuyen a otras entidades la elaboración de la misma.
- Todos los participantes son conscientes de los impactos generados por los fenómenos climáticos y demandan información para la generación de las acciones.
- Existe un amplio desconocimiento acerca de los instrumentos de planificación asociados al clima, tales como planes de adaptación o mitigación, incluso no conocen muy bien los instrumentos de ordenamiento como POMCAS y POTs.
- Los participantes, casi en su totalidad destacaron la poca articulación que hay entre las instituciones, situación que crea gran confusión.
- Existe la necesidad de educación sobre los términos, conceptos e información para los usuarios, basado en los conceptos de tiempo y clima, las escalas de la información, entre otra cosas.

Anexos

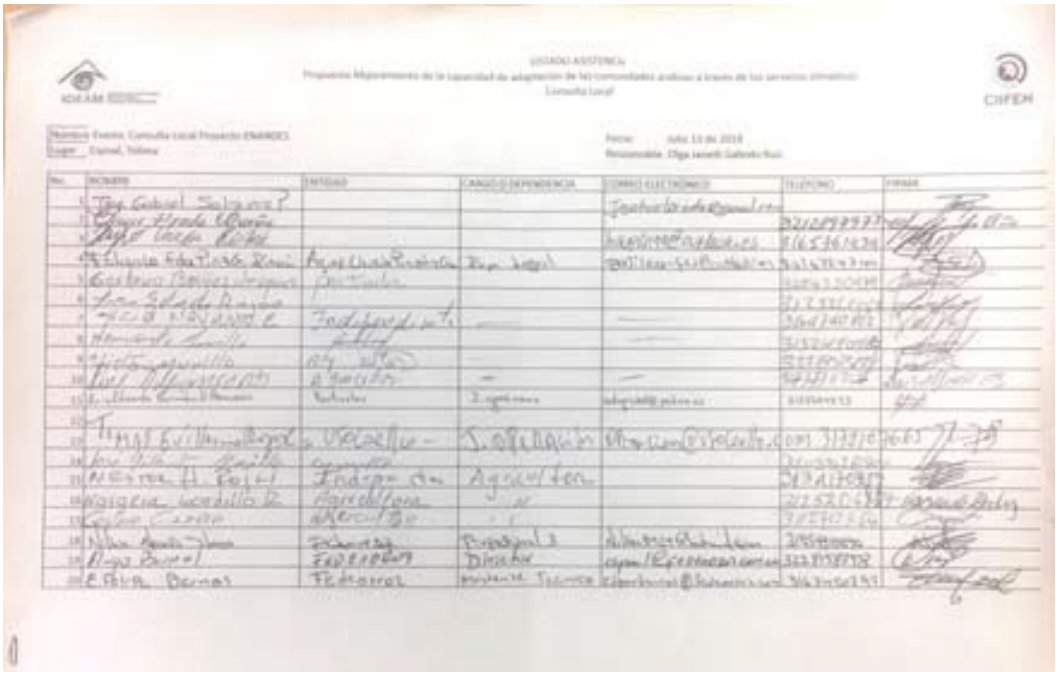
	

Matriz de Reporte de Consultas Nacionales
País/Ciudad/Sede del Taller/Fecha Colombia, Tolima, Espinal. Auditorio Fedearroz. Julio 13 de 2018.
Equipo Facilitador Luis Reinaldo Barreto, IDEAM Olga Janeth Galindo Ruiz, CIIFEN
Institución Anfitriona Fedearroz
Descripción Participantes Pequeños productores rurales de arroz
Hallazgos sobre qué información (productos, frecuencia, resolución) del SMHN necesitan los productores de arroz para mejorar sus planes de gestión de riesgos climáticos (prevención, preparación y respuesta). La principal problemática manifestada por el grupo de productores participantes son los impactos sobre el cultivo que causan las temperaturas extremas y cambios de la misma dados en cortos periodos de tiempo, por tanto demandan información diaria como mínimo (mencionan que en los posible sea 3 veces al día) que les permita prepararse e implementar medidas como el manejo del riego para asegurar que no le falte la humedad al cultivo. Conocer localmente los datos de precipitación, brillo solar, humedad relativa, temperaturas máximas o mínimas, velocidad del viento. Análisis de impactos de variabilidad climática. Tener acceso a información del comportamiento de las variables climáticas en las partes altas de la cuenca.
Hallazgos sobre qué información (productos, frecuencia, resolución) del SMHN necesitan los productores de arroz para mejorar o diseñar sus planes de adaptación al cambio climático a largo plazo en su respectivo sector. En la zona existe un distrito de riego del que se surten los cultivos. Es necesario conocer la información predictiva de precipitaciones o épocas de sequía, con el objeto de tener un cronograma apropiado de riegos y establecer un programa de siembra adecuado. Conocer en detalle medidas de adaptación como los reservorios de agua, su diseño y manejo. Se propone el diseño e implementación de aplicaciones de celular que permitan el acceso fácil a datos locales y regionales. Información de lluvias mes a mes, basado en un centro o red de información con datos de estaciones de la zona. Conocimiento sobre tecnologías para mitigar los efectos de la variabilidad climática sobre los cultivos.
Hallazgos sobre cuáles son las barreras (acceso, comprensión, escasa articulación, capacitación, empoderamiento local, etc.) que impiden la aplicación de la información entregada por los SMHN para: 1) La gestión de riesgos (prevención, preparación y respuesta) y toma de decisiones en los sectores agricultura, agua y energía; y 2) Los planes y acciones locales de gestión de riesgos y adaptación. • Hay poca credibilidad sobre la información que genera el IDEAM • La escala de la información es muy amplia • No hay conocimiento claro de cómo acceder a la información • No hay claridad acerca de la expresión de los datos, es decir, no saben lo que puede significar el dato respecto a su actividad productiva.

Análisis de percepciones de los actores locales:

El gremio arrocero no posee como tal un plan de adaptación al cambio climático, sin embargo, implementan desde hace aproximadamente 7 años un programa denominado Adopción Masiva de Tecnología (AMTEC), esta estrategia pretende disminuir el impacto del cambio climático a través de transferir las tecnologías de manejo del cultivo disponibles que incrementen la productividad y disminuya los costos de producción con el menor impacto sobre el medio ambiente. Para la generación y diseño de estas tecnologías se utiliza la información generada por el IDEAM. De acuerdo a la entrevista telefónica realizada a la coordinación de este proceso en FedeArroz, existe una clara necesidad de aumentar la cobertura del programa a otros territorios (el sector en el que realizamos el taller aún no está dentro del programa) y de mejorar la red de estaciones, puesto que la información emitida por el IDEAM es de una escala regional o municipal en el mejor de los casos.

Los participantes del taller manifiestan la necesidad de articulación entre las instituciones, y establecer claramente para ellos las competencias de cada una. Igualmente, es necesario armonizar las actividades del cultivo y programas de adaptación a los planes de ordenación de las cuencas hidrográficas, ya que el cultivo es tan dependiente de la oferta del recurso hídrico.



Matriz de Reporte de Consultas Nacionales
País/Ciudad/Sede del Taller/Fecha Colombia, Popayán, Cauca. Auditorio Empresa de Acueducto de Popayán. Julio 12 de 2018.
Equipo Facilitador Luis Reinaldo Barreto, IDEAM Olga Janeth Galindo Ruiz, CIIFEN
Institución Anfitriona Empresa de Acueducto de Popayán.
Descripción Participantes • Representantes de acueductos rurales. • Participantes del proyecto "Custodios de Semillas", de la Empresa de Acueducto. • Representantes de Cabildos Indígenas Puracé • Miembros de asociaciones de productores campesinos (Asocampo) • Funcionarios de la Empresa de Acueducto En total se contó con la participación de 40 personas.
Hallazgos sobre qué información (productos, frecuencia, resolución) del SMHN necesitan los representantes de los sectores: agricultura y agua para mejorar sus planes de gestión de riesgos climáticos (prevención, preparación y respuesta) en su respectivo sector. • Necesidad de una red local de monitoreo climático a microcuencas, que emita reportes periódicos (diarios, semanales, mensuales, trimestrales y semestrales) • Boletines de fácil interpretación con conceptos claros para agricultores y comunidad en general. • Información de escala local. • Pronósticos diarios y mensuales. • Medios de comunicación de fácil acceso como mensajes de texto a travésde celulares y emisoras comunitarias.
Hallazgos sobre qué información (productos, frecuencia, resolución) del SMHN necesitan los representantes de los sectores agricultura y agua para mejorar sus planes de adaptación al cambio climático a largo plazo en su respectivo sector • Ampliar el número de variables que se reportan normalmente, a otras como humedad, brillo y luminosidad solar, velocidad de los vientos. • Medidas de adaptación ilustradas, es decir, a través de mecanismos que pueden ser gráficos que permitan un mejor entendimiento por parte de los usuarios. • Información analítica sobre los impactos sobre sus actividades productivas y sobre prevención de las mismas.
Hallazgos sobre cuáles son las barreras (acceso, comprensión, escasa articulación, capacitación, empoderamiento local, etc.) que impiden la aplicación de la información entregada por los SMHN para: 1) La gestión de riesgos (prevención, preparación y respuesta) y toma de decisiones en los sectores agricultura, agua y energía; y 2) Los planes y acciones locales de gestión de riesgos y adaptación • La escala de la información es muy gruesa, no permite tomar decisiones sobre territorios pequeños. • No se conoce con exactitud dónde se puede consultar la información. • La información brindada no es clara para los usuarios.

Análisis de percepciones de los actores locales:

- En general la percepción de los participantes es negativa frente a la información generada por IDEAM, la forma de consultarla no es clara y mucho menos su comprensión.
- El común denominador de los asistentes mencionó la necesidad de capacitación en el manejo de instrumentos y en la interpretación de la información generada.
- Como punto adicional a lo expuesto por los participantes en el taller relacionado con las necesidades de información, éstos destacaron la necesidad de contar con redes de información conformada por voluntarios locales y con elementos sencillos de comunicación como altavoces, en apoyo a las alertas ante fenómenos o eventos.
- Las administraciones municipales según se documentó en el taller, son un punto focal fundamental donde se puede depositar la información y donde los usuarios pueden acceder a ella fácilmente.
- No es claro para la mayoría de participantes, las competencias y funciones de las instituciones; por tanto, no hay claridad acerca de quien genera la información necesaria para la toma de decisiones relacionadas con el clima.

ADAPTATION FUND

INFORME DEL SEMINARIO TALLER SOBRE SERVICIOS CLIMÁTICOS PARA LA ADAPTACIÓN A LOS IMPACTOS DEL CLIMA EN LA AGRICULTURA

Antecedentes generales del encuentro

El Seminario-Taller sobre Servicios Climáticos para la adaptación a los impactos del clima, se realizó en la ciudad de Quillota, en dependencias de la Secretaría Regional de Agricultura de la región de Valparaíso, con el propósito de establecer un diálogo directo entre los organismos encargados de elaborar servicios climáticos y los usuarios de la información meteorológica y climática, en sectores relevantes de la región, como son la agricultura, la gestión de recursos hídricos y la energía, en el marco de la actividad de Consultas Nacionales asociadas a la elaboración de la Nota de Concepto del proyecto "Enhancing Adaptative Capacity of Andean Communities through Climate Services" (ENANDES), el que será presentado al Fondo de Adaptación (FA).

Esta actividad fue desarrollada por la Sección de Emergencias y Gestión de Riesgos Agrícolas y la Dirección Meteorológica de Chile, con el Equipo regional de la Secretaría Regional Ministerial de Agricultura de la Región de Valparaíso.

La zona piloto del proyecto es la Cuenca de Aconcagua, ubicada en la provincia de Quillota, en la Región de Valparaíso.

El Seminario Taller, sobre servicios climáticos para la adaptación a los impactos del clima en la agricultura, se realizó el 05 de julio en el Salón Auditorio de la Secretaría Regional Ministerial de Agricultura de la Región de Valparaíso (Freire 765 – Quillota), Chile.

Participantes del taller

Se convocó a 32 personas, cuyos participantes representaron a:

- La Asociación de Agricultores de Quillota y Marga Marga.
- La Junta de Vigilancia de la Tercera Sección del Río Aconcagua.
- Los programas de apoyo a los agricultores (PRODESAL, PDTI,SAT, etc.).
- Ministerio de Agricultura: Secretaría Regional Ministerial de Agricultura Región de Valparaíso y sus Servicios del agro: Servicio Agrícola y Ganadero (SAG); Corporación Nacional Forestal (CONAF); Instituto de Investigaciones Agropecuarias (INIA); Instituto de Desarrollo Agropecuario (INDAP) y la Sección de Emergencias y Gestión de Riesgos Agrícolas.
- Dirección Meteorológica de Chile, a través de su Subdepartamento Climatología y Meteorología Aplicada, Dirección Meteorológica de Chile y de su Sección de Meteorología Agrícola.
- Instituciones vinculadas a los recursos hídricos: Dirección General de Aguas (DGA); Dirección de Obras Hidráulicas (DOH).
- Instituciones de investigación como universidades.

Objetivo del encuentro

Identificar las brechas de los servicios meteorológicos e hidrológicos nacionales para que éstos respondan a los requerimientos y necesidades de sus usuarios/beneficiarios.

Metodología

Etapas de la actividad

La actividad consistió en un Seminario taller con etapas, desarrolladas en una jornada de trabajo (ver Programa): presentación del proyecto y del marco conceptual de los servicios climáticos meteorológicos e hidrológicos; presentación de los servicios climáticos disponibles para el agro; mesas de trabajo para el análisis de brechas en cuanto a servicios climáticos (disponibilidad, acceso, y pertinencia de los servicios climáticos, equidad de género, necesidades de difusión y de fortalecimiento de capacidades en el uso de estos servicios, etc.).

Caracterización de los participantes

Se realizó a través de una encuesta elaborada por la Sección de Emergencias y Gestión de Riesgos Agrícolas y la Sección de Meteorología Agrícola de la Dirección Meteorológica de Chile, con el apoyo propuestas desarrolladas por CIIFEN (Ver Formato en ANEXO).

Mesas de trabajo

La discusión se desarrolló en 3 mesas de trabajo con un máximo de 6-8 participantes, con un moderador. Los participantes se distribuyeron en grupos heterogéneos. Para la discusión se elaboró un cuestionario de 3 preguntas y se trabajó con tarjetas. Además, se elaboró un glosario de apoyo para la discusión.

Previamente al inicio del trabajo se presentó la metodología de trabajo y se entregó el cuestionario a cada uno de los participantes.

Programa

Horario	Actividad
08:30 – 09:00	**Recepción e inscripción de los participantes.**
09:00 – 09:30	**Palabras de bienvenida y presentación de la actividad.** *Sr. Humberto Lepe, SEREMI de Agricultura - Región de Valparaíso* *Sr. Antonio Yaksic, Jefe SEGRA - MINAGRI*
09:30 – 10:00	**Presentación del Proyecto ENANDES** *Sr. Enrique Garrido, Jefe Subdepartamento Climatología y Meteorología Aplicada, Dirección Meteorológica de Chile (DMC)*
10:00 – 10:30	**Meteorología, Cambio Climático y Adaptación en la Agricultura** *Sr. Juan Quintana, Jefe de la Sección de Meteorología Agrícola, Dirección Meteorológica de Chile, DMC*
10:00 – 10:20	**Servicios meteorológicos e hidrológicos para la agricultura** *Sr. Gastón Torres, Profesional de la Dirección Meteorológica de Chile (DMC)*
10:20 – 10:50	Pausa para café
10:50 – 11:10	**Servicios meteorológicos e hidrológicos para la agricultura** *Sr. Antonio Yaksic Soulé, Jefe Sección de Emergencias y Gestión de Riesgos Agrícolas (SEGRA) del MINAGRI* *Por definir, División de Hidrología, Dirección General de Aguas (DGA)*

Horario	Actividad
11:10 – 13:00	**Mesas de trabajo – Discusión sobre las necesidades de información climática a nivel local** Presentación de la metodología *Liliana Villanueva Nilo, Profesional SEGRA - MINAGRI* Organización de las mesas de trabajo *Todos los participantes*
13:00 – 13:30	**Plenaria sobre principales conclusiones y cierre de la actividad**

Resultados

Mesas de trabajo

La discusión de las mesas de trabajo se muestra en la tabla siguiente (Tabla 1). Además, hubo aportes de forma individual de 7 participantes del taller, incluidas también en el análisis (Tabla 2).

Las preguntas para la discusión fueron las siguientes:

Pregunta 1. ¿Qué tipo de información meteorológica y/o climática se necesita para las decisiones productivas en su zona? (información meteorológica como lluvias o temperaturas; información hidrológica como estado de los caudales o embalses; análisis e indicadores necesarios; alertas de heladas; otro tipo de información)

Pregunta 2. ¿Cómo le gustaría recibir la información meteorológica y/o climática que necesita y con qué periodicidad? (medios como dispositivos móviles, radio, televisión, folleto impreso, sitio web, reporte de su asesor; periodicidad: diaria, semanal, mensual, quincenal; otras).

Pregunta 3. En relación con la información agroclimática ¿Considera Usted que los canales de comunicación son los adecuados? ¿Cree Usted que esta información es de su utilidad? ¿Qué propone Usted para mejorar la información meteorológica y/o climática que recibe o pudiera recibir para apoyar sus decisiones productivas?

Tabla 2. Respuestas individuales al cuestionario.

N°	Pregunta 1	Pregunta 2	Pregunta 3
1	Agua caída a la fecha, comparación de agua caída con el año pasado, temperaturas, horas de frío acumuladas, datos para cálculo de evapotranspiración, emergencias climáticas (heladas).	Información vía correo electrónico	No consideramos que sean adecuados los medios de comunicación debido a que la información no es personalizada, ni a tiempo. Lo ideal sería que se hiciera un catastro de las organizaciones interesadas en la información y poder informarles vía correo electrónico semanalmente las condiciones o emergencias que puedan ir sucediendo.
2	Información suficiente; información segmentada a grupos agricultores.	--	--
3	Pronóstico de heladas; pronóstico de lluvias; pronóstico de horas de frío (mayor a 30°C); todo comparado con periodo anterior o 10 años	Radio; teléfono vía Whatsapp; televisión	Son adecuados pero su modalidad no es la adecuada, ya sea por dificultad a acceder a información, especulación. Debe ser confiable, acotada y de fácil acceso.
4	Información procesada histórica v/s avance de la temporada en cuanto a horas bajo 7°C y horas sobre 25°C. Datos correctos o adecuados a una norma para poder comparar bien.	Dispositivo móvil; sitio Web. Mensual. Importante la comparación permanente con la historia.	Canales de comunicación deben ser de fácil acceso. Información sirve en la medida que se procese. Informes mensuales históricos/avance actual en temperatura bajo 7°C, bajo 12°C y sobre 25°C; pluviometría.
5	Mantener información sobre lluvias, temperaturas, heladas y todas las anteriores ya que es necesario para realizar toma de decisiones en predio.	A través de dispositivos móviles, app, y radios locales para tener mayor cobertura. Periodicidad diaria, quincenal y mensual.	Actualmente no sirven para el tema agrícola, se deben adecuar. Mejorar la página Web, temáticas más amigables y con acceso para todos, sin costo involucrado.
6	Heladas, acumulación de horas de frío, tiempo que duró la helada. Comparación con años anteriores y alertas a la fecha.	Móviles, a través de app, prioridad 1 vez por semana, dependiendo si hay emergencia. Debería llegar una alerta a celulares sobre	No, porque no sirve para la parte agrícola, pero, sí para un particular que quiere hacer otra actividad. Se requiere página Web más

		algún evento, se ha hecho por ONEMI cuando hay riesgo de tsunami. Radios locales, dos veces al día, pronóstico del tiempo.	atractiva para ingresar, que entregue datos más fáciles de interpretar.
7	Principalmente se requiere información sobre la temperatura con datos duros cada dos días por ejemplo.	Vía teléfono celular, con frecuencia diaria.	Se debe mejorar las páginas Web con datos que sean más amigables y simples a la vista de profesionales y agricultores.

Análisis/interpretación de resultados

De acuerdo a las respuestas de los usuarios durante las mesas técnicas, obtenidas de la aplicaciòn del cuestionario , se deduce que las principales necesidades de los participantes son:

- Alertas agroclimáticas, como heladas, olas de calor, olas de frío, eventos severos de precipitación.
- Boletines, diarios, decadales y mensuales, que contengan estadística básica de las principales variables meteorológicas de interés para la agricultura, como son temperatura, precipitación, humedad y viento, horas de frío, entre otros.
- Pronóstico meteorológico especial para la actividad agrícola, sectorizados.
- Necesidad de pronósticos meteorológicos de largo plazo, que permitan disponer de orientaciones para la planificación y gestión de sus actividades.
- Pronósticos meteorológicos especiales, para planificar aplicaciones de pesticidas, de acuerdo a la estación del año.
- Información meteorológica estadística de un período determinado (semanal, decadal), comparado con igual período del año anterior.
- Información relacionada con balance hídrico y evapotranspiración para optimizar el manejo del riego.
- Disponer de información meteorológica (temperatura y acumulación de horas de frío), dirigida a diferentes rubros agrícolas (frutales y hortalizas).
- Información, sobre monitoreo de indicadores de sequía para la región.

En relación a los medios de difusión, las necesidades detectadas son:

- Redes sociales (whatsapp, twitter)
- Correo electrónico.
- Televisión, radioemisoras y diarios locales. 4.- Página Web, aplicaciones móviles

Sugerencias de los usuarios:

- La información agrometeorlógica que manejan actualmente no es sufciente para satisfacer sus necesidades operativas.
- Mejorar los sistemas de acceso a la información, haciéndolos más amigables. 3.- Se requiere capacitación para el manejo de los sistemas de comunicación.
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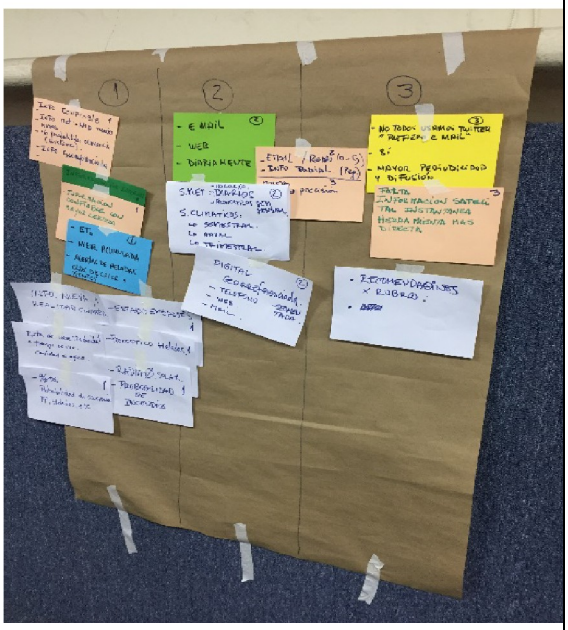


Fotos del taller de Quillota.

INFORME TÉCNICO - SENAMHI – PERU

TALLER DE CONSULTA CON USUARIOS EN AMBITO DE INTERVENCIÓN DEL PROYECTO

1 Antecedentes

La Organización Meteorológica Mundial (OMM), conjuntamente con los Servicios Meteorológicos de Colombia, Chile y Perú, así como el Centro Internacional de Investigación del Fenómeno El Niño (CIIFEN) han presentado el proyecto: Mejoramiento de la capacidad adaptativa de comunidades andinas a través de Servicios Climáticos (ENANDES) a la convocatoria del Fondo de Adaptación (FA). Propuesta que tiene como objetivo general contribuir a la reducción de la vulnerabilidad e incrementar la resiliencia de comunidades andinas en Perú, Colombia y Chile, a la variabilidad climática y el cambio climático, para una mejor gestión del agua, para generación de energía hidroeléctrica y para la agricultura. De esta forma contribuirá en la generación de información relevante para la implementación de las Contribuciones Determinadas a Nivel Nacional (NDC) en las temáticas de agua, energía y agricultura, compromisos internacionales del país.

Con el objetivo de preparar las actividades para el Proyecto, se organizó una primera reunión técnica en Lima, el 25 de junio del 2018, con participación de especialistas de todos los socios nacionales participantes del Proyecto (Ministerio del Ambiente (MINAM), Ministerio de Energía y Minas (MEM), Ministerio de Agricultura y Riego (MINAGRI), Centro Nacional de Estimación, Prevención y Reducción del Riesgo de Desastres (CENEPRED), Instituto Nacional de Defensa Civil (INDECI) y Autoridad Nacional del Agua (ANA) con fines de validar los ámbitos de intervención del Proyecto así como definir actividades para los talleres de consulta a ser realizados.

En este contexto, se llevaron a cabo dos talleres en uno de los ámbitos de intervención del proyecto (Cuenca del río Rímac), a fin de levantar información de usuarios de la información climática y asimismo evidenciar las dificultades, limitaciones o barreras para su acceso, comprensión, uso y aplicación en acciones individuales, colectivas o institucionales para la reducción de los riesgos asociados al clima e implementar acciones de adaptación. Los talleres fueron organizados conjuntamente con todos los socios nacionales.

El primer taller se realizó el 11 de julio 2018, en la localidad de Matucana, provincia de Huarochirí, departamento de Lima, a 2400 msnm, donde se abordaron las mesas temáticas de agropecuaria, agua y gestión de riesgos y el segundo el 13 de julio 2018, en la ciudad de Lima, donde se abordó la mesa temática de energía. Los resultados se muestran en cuadros resúmenes, asimismo se evidencian la participación de los usuarios a través de fotografías de los participantes e imágenes de las listas de participantes y encuestas.

2 Objetivos

Los objetivos específicos de los talleres fueron los siguientes

- Identificar peligros y prácticas de adaptación en el sector agrario, gestión de riesgos y energía
- Identificar la necesidad de información climática para cada sector.
- Identificar barreras por las que no se tiene acceso o no se utiliza la información climática.
- Compilar recomendaciones prácticas de los participant

3 Metodología

Las mesas de trabajo fueron facilitadas por el SENAMHI y el CIIFEN y asimismo contaron con la participación de los socios nacionales de las instituciones técnicas.

Para ambos talleres se establecieron las siguientes actividades:

- Exposición sobre los objetivos del proyecto, ámbitos de intervención, componentes. La contribución de la propuesta a los objetivos de las Contribuciones Nacionalmente Determinadas (NDC) en agricultura y agua a cargo de SENAMHI y MINAM.
- Mesas de trabajo donde los participantes identificaron la información relevante, en base a preguntas claves establecidas.
- Completación de encuesta.
- Sesión plenaria, donde cada mesa temática presentó las conclusiones. Esto se aplicó en Matucana.

3.1 Taller sobre Agua, Agricultura y Gestión de Riesgos-Matucana

- Luego de las exposiciones se crearon 5 grupos de trabajo, los que se distribuyeron en 3 sectores priorizados:
- Sector Agropecuaria (2 mesas)
- Sector Agua (2 mesas)
- Sector Gestión de riesgo (1 mesa)
- Se entregó a los asistentes las tarjetas por cada pregunta.
- Se motivó a los participantes, surgiendo varios comentarios, dudas y respuestas a las preguntas claves, los mismos que fueron anotados en las tarjetas.
- Para los peligros identificados se estableció una priorización, en base a votación in situ de los participantes.

3.2 Taller sobre Energía – Lima

- Luego de las exposiciones, un especialista en hidrología se encargó de iniciar las conversaciones con los usuarios sobre preguntas clave, relatándose al final las conclusiones del mismo.

4 Consulta local a usuarios de Agua, Agricultura y Gestión de Riesgos – Localidad de Matucana

El Taller con usuarios de agricultura, agua y gestión de riesgos se realizó en el Centro Cívico de la Municipalidad de Matucana, provincia de Huarochirí, departamento de Lima, a 2400 msnm, el 11 de julio del 2018.

Participaron como anfitriones especialistas de las Direcciones de Meteorología, Hidrología, Agrometeorología y Dirección Zonal Lima del SENAMHI, la Dirección Zonal Lima/AGRORURAL/Ministerio de Agricultura y Riego, Gerencia Ambiental-Municipalidad Provincial de Huarochirí- Matucana y las Instituciones socias: Ministerio del Ambiente (MINAM), Ministerio de Agricultura y Riego (MINAGRI), Centro Nacional de Estimación, Prevención y Reducción del Riesgo de Desastres (CENEPRED), Instituto Nacional de Defensa Civil (INDECI) y Autoridad Nacional del Agua (ANA).

Se contó con el apoyo de AGRORURAL/MINAGRI para la convocatoria. Se establecieron tres mesas temáticas: agropecuaria, agua y gestión de riesgos, participaron representantes de instituciones técnicas y líderes de comunidades campesinas para la mesa temática de agricultura, representantes de comités de regantes para la mesa temática de agua y representantes de autoridades y gobernadores para la mesa temática de gestión de riesgo. Asistieron un total de 98 participantes, de los cuales 71,5% varones y 28,5% de mujeres.

En la mesa temática de **agropecuaria,** bajo la coordinación de especialistas en agrometeorología del SENAMHI y del MINAGRI, se trabajaron con participantes técnicos de la Agencia Agraria Santa Eulalia, Agrorural-Santa Eulalia y Zonal Lima, así como representantes de las comunidades campesinas de: Soca, Paroc, San Juan, Chauta, Purhuay, San Mateo, San Pedro de Huancay, Laraos, Huanza, Caracancha, Collana, Mariatana,, Llambilla, Cochacra, San Mateo, Copara, Viso, Tupicocha, Surco, entre otros.

En la mesa temática de **agua**, con la coordinación de especialistas en Hidrología del SENAMHI, del ANA y del MINAM, se trabajó con los representantes del Comité de riego de San Mateo, Santa Eulalia, Viso, Comité de Regantes de Santa Eulalia, Junta de usuarios de agua del Rímac, Comité de agua de Purhuay, Chaupimarca, Pacaychico; Canal de Pacomanta, Comité de usuarios de agua de Huancate, Songollo, Laraos, entre otros.

En la mesa **de gestión de riesgos**, con la coordinación de especialistas en meteorología del SENAMHI y de gestión de riesgos de CENEPRED e INDECI, se trabajaron con representantes del Gobierno Regional de Lima (GORE-Lima), el Centro de Operaciones de Emergencia Nacional (COEN), así como representantes de las municipalidades distritales de Matucana, San Mateo, San Juan de Iris, Mariatana, Antioquia, Chicla, Surco, Callahuanca, Santa Eulalia, Ahuillay Matu, Viso, San Pedro de Casta, Laraos; entre otros.

Percepción sobre los peligros e impactos

Con respecto a los peligros que les afectan, se consideran con mayor prioridad las lluvias intensas y sus efectos como los deslizamientos y las inundaciones así como las heladas en las partes altas, en siguiente prioridad las sequías, altas temperaturas y los vientos fuertes.

Como impactos de los peligros se mencionan: pérdidas de terrenos agrícolas y de cultivos, pérdidas de vidas humanas, desnutrición y mortandad de animales, bajo rendimiento de leche de ganado, aparición de plagas y enfermedades, pérdidas de pastos, daños en canales y tomas de regadío, migración de jóvenes, interrupción de carreteras y caminos de acceso, entre otros.

Productos para mejorar sus planes de gestión de riesgos climáticos:

- Boletines con pronósticos climáticos e hidrológicos con anticipación a la campaña agrícola
- Pronóstico de heladas, lluvias intensas.
- Sistemas de alerta temprana
- Talleres de capacitación sobre eventos climáticos, prevención de impactos, riego, gestión de riesgos, etc.

Productos para mejorar sus planes de adaptación al cambio climático:

- Escenarios de clima futuro
- Zonificación para diversificación productiva en cultivos
- Capacitación sobre implementación de medidas de adaptación, agricultura orgánica, siembra y cosecha de agua, etc.

Barreras que impiden el uso de la información:

Excepto para los representantes de la mesa temática de gestión de riesgo de desastres, que mostró mayor conocimiento sobre las actividades del SENAMHI, los usuarios de las mesas de agropecuaria y agua (comités de regantes) manifestaron desconocer en su mayoría las actividades del SENAMHI, tampoco sobre sus productos, manifestando la poca notoriedad, y como barreras el no tener acceso al internet, la falta de comunicación con sus autoridades locales y entes técnicos como agentes zonales de agricultura y riego.

Los usuarios de la mesa de gestión de riesgos mencionaron que sí conocen la actividad del SENAMHI, sin embargo un bajo porcentaje manifestó utilizar sus productos, mencionando como barreras la falta de acceso a los medios de comunicación y difusión, oportunidad y disponibilidad, falta de prioridad en la agenda política para trabajar el tema de clima para la gestión del riesgo, deficiente comprensión de los productos, mapas poco detallados, lenguaje muy técnico, no contar con estaciones meteorológicas, falta de capacitación, etc.

Género y juventud

Con respecto a la participación de la mujer, la mayoría de los participantes menciona que sí participa en la administración y/o toma de decisiones vinculadas con la producción agropecuaria y la disponibilidad hídrica, y asimismo que sí accede a la información, capacitación y educación formal ; sin embargo, con respecto a que si la agricultura pueda crear oportunidades para los jóvenes, una gran mayoría considera que no existen

oportunidades, que requieren mayor tecnología, mayor capacitación y se debe crear incentivos para evitar la migración.

Propuesta

- Representantes de la mesa de gestión de riesgo manifestaron recibir la información del SENAMHI mediante los COER (sectores de salud y educación), sin embargo, existe una deficiente articulación entre estos sectores, por lo que solicitan se utilice como centro de recepción y difusión de la información climática a los Comités de Regantes.
- Solicitan masificar la información por radio local y mensajes de texto, TV local
- Sugieren elaborar e implementar instrumentos de gestión (planes de contingencia ante sequías y lluvias intensas)

5 Consulta local a usuarios de ENERGÍA-Lima

El Taller con usuarios del Sector energía fue realizado en la Sala de Capacitación del SENAMHI, distrito de Jesús María, Provincia de Lima, Departamento de Lima, el 13 de julio del 2018. Participaron como anfitriones especialistas de las Direcciones de Meteorología e Hidrología del SENAMHI y del Ministerio del Ambiente.

El taller de Energía fue orientado a la cuenca del Río Rímac, por cuanto los representantes del sector energía que operan en esta cuenca, tienen su sede en la ciudad capital Lima. Participaron como representantes del Sector: ELECTROPERÚ, el Organismo Supervisor de la Inversión en Energía y Minería (OSINERGMIN) y el Ministerio de Energía y Minas (MEM), y como representante del sector privado: AUSTER ENERGÍA.

Percepción sobre los peligros e impactos

Con respecto a los peligros que les afectan, se consideran con mayor prioridad las lluvias intensas y sus efectos como los deslizamientos y las inundaciones, en segunda prioridad las sequías y en menor prioridad los vientos, nevadas, granizadas, tormentas eléctricas. Como impactos de los peligros se mencionan:

- Arrastre de sedimentos por huaycos y deslizamientos, colmatación de cauces, inundación. Restricción y disminución en la producción energética. Disminución de la producción por causa de la sequía.
- Altas pérdidas económicas por las tuberías de gas, infraestructura hidráulica, turbinas.
- Si el viento es intenso, quema de aerogeneradores (sobrecarga).

Productos para mejorar sus planes de gestión de riesgos climáticos:

- Datos de lluvia, temperatura, caudales y evaporación.
- Pronósticos de 48 a 72 horas de caudales y vientos (Ráfagas)
- Sistema de Alerta Hidrológico

Productos para mejorar sus planes de adaptación al cambio climático:

- Escenarios de disponibilidad hídrica (presente y futuro)
- Información climática más detallada en medio digital
- Disponibilidad de datos en cuencas de mayor potencial hídrico
- Mapas de energía solar y eólica.

Barreras que impiden el uso de la información:

Los usuarios manifiestan que sí reciben o tienen acceso a la información climática, sin embargo existen dificultades para su uso:

- Oportunidad y disponibilidad.
- Mejorar formatos.
- Mensaje muy técnico.
- Falta de articulación con el Sector.

Propuesta:

- Plataforma con información integrada y más útil para el sector.
- Mejorar la gestión con el MEM, convenios con las áreas de Concesiones y Electricidad.

A continuación se presentan los cuadros resúmenes para las mesas temáticas de agricultura, agua, gestión de riesgos y energía.

AREA TEMÁTICA: AGROPECUARIA

Peligros(*)	Impactos y/o afectaciones	Prácticas de adaptación atenuación de impactos	Acceso, uso , barreras y propuesta	
1.Heladas 2. Lluvias repentinas (cambio de patrones). 3. Sequías 4. Altas temperaturas Los Huaycos y deslizamientos como producto de las lluvias.	• Pérdidas de terrenos agrícolas (daños en los cultivos de maíz, trigo, alfalfa, papa, habas, alverja). • Desnutrición y mortandad de animales (generalmente terneros) • Bajo rendimiento de leche en el ganado vacuno • Afectación de la floración en algunos frutales • Daños en vacunos (mal de altura) • Aparición de algunas enfermedades/plagas en las plantas • Caracol negro (asociado a cambios en la intensidad de las lluvias) • Pulgón blanco (palto), (asociado a altas T°) • Mancha negra en la hoja (asociado a la humedad relativa alta) • Araña roja (asociado a las altas T°) • Pérdidas de pastos (por heladas) • Daños en los canales y tomas de regadío • Incremento de roedores • Migración de jóvenes a otras ciudades.	Se mencionaron algunas prácticas de adaptación o de atenuación de impactos: • Siembra de quinuales (acción realizada por el proyecto PRONAMACHS • Riego tecnificado • Uso del mulch o alcochado • Cobertizos • Amunas (siembras de agua en las partes altas) Aplicación de vacunas en animales • Aplicación de abono foliar en frutales • Barreras con árboles • Quema de pastos y rastrojos. Sin embargo, un alto % de participantes mencionó que no efectúa ninguna práctica ante los eventos climáticos extremos por falta de capacitación. Solicitan acciones preventivas a través de capacitación: Capacitaciones: para prevención de daños climáticos, para implementación de siembra de agua y riego tecnificado, agricultura orgánica para prevenir plagas, cambio climático.	**SI:** Bajo% recibe **Porqué medio lo recibe:** Radio local, TV	**NO:** Un mayor % manifestó no recibir ni usar la información del SENAMHI. **Barreras:** • Falta de comunicación directa con las instituciones, gobiernos locales y regionales • No llega la información • Deficiente comprensión de la información **Tipo de información que les gustaría recibir** • Capacitaciones en temas de clima • Boletines con pronósticos climáticos antes y durante la campaña agrícola. • Pronóstico de heladas • Zonificación de cultivos

(*): Los peligros se encuentran enumeradas por orden de priorización

AREA TEMÁTICA: AGUA

Peligros (*)	Impactos y/o afectaciones	Prácticas de adaptación/atenuación de impactos	Acceso, uso , barreras y propuesta	
• Lluvias fuertes • Sequias • Huaycos • Heladas • Días más cálidos • Noches más frías	• Pérdida de producción y calidad de productos agrícolas • Daños a la infraestructura hidráulica (mayormente canales) • Interrupción y destrucción de vías de comunicación • Pérdidas humanas • Mortandad de animales • Daños y pérdidas de casas • Afectación a la salud de los pobladores. • Los impactos afectan mayormente al sector económico, agrícola y ganadero	Se mencionaron algunas prácticas de adaptación o de atenuación de impactos: • Mejorar la infraestructura de riego • Construcción de reservorios • Siembra de agua y zanjas de infiltración • Limpieza y descolmatación de canales • Reforestación • Andenerías • Regulación del uso de agua para consumo humano y la agricultura. • Elaboración e implementación de instrumentos de gestión (planes de contingencia ante sequias y lluvias intensas)	**<u>.SI:</u>** Un bajo % recibe. **¿Qué tipo de información?** • Información de COER (pronósticos) • Datos meteorológicos históricos/SENAMHI **¿A través de qué medio se informa?** • Radio Local/municipal Existe una radial "Ecoradio", que a veces transmite información de clima) • Internet • TV • Boletines/trípticos	**<u>NO:</u>** Un mayor % manifestó no recibir ni usar la información del SENAMHI. **Barreras:** • Falta de especialistas en clima y recursos hídricos • Falta de acceso a medios de comunicación (celular, en ciertos casos radial) • Falta de prioridad en la agenda política para trabajar temas de clima (poblacional e institucional) • No existen suficientes estaciones hidrometeorológicas • No existe articulación de acciones de difusión • No tienen acceso a internet • Deficiente comprensión de la información, lenguaje muy técnico. **Tipo de información que les gustaría recibir y medios:** • Pronóstico climático, hidrológico y de lluvias • intensas • Talleres de capacitación en temas de clima • Pautas para la implementación de Sistemas de Alertas Tempranas (SAT). • Por medios radial y cursos/talleres de capacitación.

(*): Los peligros se encuentran enumerados por orden de priorización

AREA TEMÁTICA: GESTIÓN DE RIESGOS

Peligros	Impactos y/o afectaciones	Prácticas de adaptación/atenuación de impactos	Acceso, uso , barreras y propuesta	
San Mateo: • Heladas • Sequía • Lluvias Intensas Santo Domingo de los Olleros: • Huaycos (Valle de Chilca y de Chamauri) San Lorenzo de Quinti: • Friaje • Heladas • Matucana: • Lluvias torrenciales • Huaycos por desborde de rio Chucumayo • Deslizamientos • Sequias • Santa Eulalia: • Fuertes lluvias • Huaycos • Incremento de radiación • Sequias • Cocachacra: • Baja temperatura • Vientos fuertes Coranche Huarochiri (cuenca alta):	• Interrupción de carreteras y caminos de acceso al predio rural • Colmatación del rio Chucumayo • Pérdida de infraestructura de riego y cosechas • Escasa agua para riego y para la alimentación producto del descenso del nivel de agua en los manantiales. • Afectación a la salud • Destrucción de viviendas y puentes • Reprogramación de actividades educativas • Muerte de animales, por las heladas.	Se mencionaron algunas prácticas de adaptación o de atenuación de impactos: • Realizar zanjas de infiltración • Construcción de diques • Construcción de cochas • Reforestación • Cierre de bocatomas • Construcción de reservorios • Construcción y mejoramiento de canales de riego • Limpieza de canales o acequias • Campañas de capacitación de prevención frente a heladas • Implementar Sistemas de Alerta Temprana-SAT	Un alto % manifestó conocer las actividades de SENAMHI relacionada a la provisión de datos y pronósticos. Sin embargo, un bajo % manifestó que utiliza la información generada para planificación de riesgos. INDECI, transmite información al COER (sectores salud y educación), pero manifiestan que existe una deficiente articulación y difusión.	**NO:** Un mayor % de los participantes de la mesa, indicaron que no acceden y no usan la información climática. **Barreras:** • No es notorio • No saben de la información, ni de la web del SENAMHI • No tienen cobertura/acceso a internet • No conocen, no lo entienden, muy técnico, no está disponible con datos locales. • Poca anticipación • Mapas poco detallados. **Tipo de información que les gustaría recibir** • Boletines semanales y/o quincenales de pronóstico del clima y caudales. • Que exista difusión de información climática a través de la radio ymensajes. • Que se utilice como centro de recepción y difusión de la información a los Comités de Regantes. • Cambio climático

• Heladas				

AREA TEMÁTICA: ENERGÍA

Peligros	Impactos y/o afectaciones	Prácticas de adaptación/atenuación de impactos	Acceso, uso, barreras, propuesta	
• Lluvias • Sequías • Vientos	• Arrastre de sedimentos por Huaycos y deslizamientos, • colmatación de cauces, inundación. Restricción y disminución en la producción energética. • Disminución de la producción por causa de la sequía. • Altas pérdidas económicas por las tuberías de gas, infraestructura hidráulica, Turbinas. • Si el viento es intenso, quema de aerogeneradores (sobrecarga).	• Afianzamiento hídrico por causa de la sequía, construcción de presas de regulación. • Plan de descarga • Diversificación de fuentes • Estar alertas a informes o pronósticos climáticos • Sistema de alerta hidrológico. • Promoción de energías renovables.	**Reciben:** • Información de pronósticos de la web de SENAMHI • Información de caudales del COES. • Requieren: • Datos de lluvia, temperatura, caudales y evaporación. • Escenarios de disponibilidad energética (presente y futuro) • Pronósticos de 48 a 72 horas de caudales, y vientos (Ráfagas) • Información climática más detallada en medio digital • Disponibilidad de datos en cuencas de mayor potencial hídrico • Mapas de energía solar y eólica	Barreras: • Oportunidad ydisponibilidad. • Mejorar formatos. • Mensaje muy técnico. • Falta de articulación con el Sector. Propuesta: • Plataforma con información integrada y más útil para el sector. • Mejorar la gestión con el MEM, convenios con las áreas de Concesiones y Electricidad.

PRIMERA REUNIÓN DE COORDINACIÓN CON SOCIOS NACIONALES, LIMA, 25 JUNIO 2018

ADAPTATION FUND

TALLER CON USUARIOS DE AGROPECUARIA, AGUA Y GESTIÓN DE RIESGOS

MATUCANA, 11 DE JULIO DEL 2018

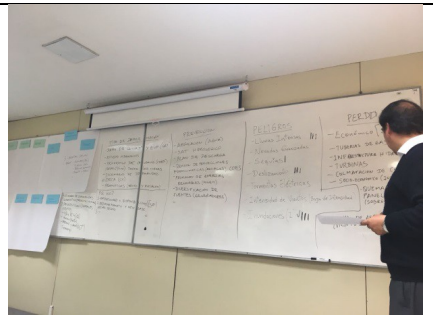
MESAS TEMÁTICAS DE AGROPECUARIA

MESAS TEMÁTICAS DE AGUA

MESA TEMÁTICA DE GESTIÓN DE RIESGOS

EQUIPO TÉCNICO DEL TALLER DE CONSULTA EN MATUCANA

TALLER DE CONSULTA CON USUARIOS DE ENERGÍA, LIMA, 13 DE JULIO DEL 2018



EQUIPO TÉCNICO DEL TALLER EN LIMA

Annex 5. WMO Checklist for Climate Services Implementation.

WMO has developed a climate services baseline analysis. The data consist of 137 yes/no responses to a checklist that addresses functional capacities across the climate services value chain. Functional capacities assessed by the checklist are organized into seven groups: the first four groups – observing networks, data and data management, monitoring, and forecasting systems – comprise the basic system needed to underpin the delivery of products and services. The other three categories – user interface, provision and application of climate services, and monitoring and evaluation of the results of end uses – are focused on the service delivery aspects of the value chain. Each functional capacity assessed by the checklist constitutes a contribution to a "basic," "essential," "full," or "advanced" level of climate services capability within a particular group. When a sufficient number of requirements has been satisfied across all groups, the overall level of service can be classified according to criteria provided by the WMO Commission for Climatology (CCl) (see below Table 1, Climate services categories).

Table 1: Climate services categories

Category	Criteria
0	Does not fully meet the criteria for Category 1
1	Basic – Design, operation and maintenance of national observing systems; data management including quality assurance; development and maintenance of data archives; climate monitoring; climate diagnostics and climate analysis; climate assessment; dissemination of climate products via a variety of media; and, participation in regional climate outlook forums (RCOFs) and some interaction with users.
2	Essential – Meet the criteria for Category 1; Develop and provide operational monthly and longer climate predictions including seasonal climate outlooks; conduct or participate in regional and national climate outlook forums (NCOF); interact with users in various sectors to identify their requirements and, provide advice on climate information and products.
3	Full – Meet the criteria for Category 2; Develop and/or provide tailored and downscaled climate products on timescales ranging from seasonal to climate change in order to meet the needs of major sectors; engage at least with some user communities; provide a strong user interface along with technical expertise for training climate specialists and for developing curricula; and, provide some level of regional cooperation and support.
4	Advanced – Meet the criteria for Category 3; Provide advanced climate services with research and modelling capabilities for climate and applied climate studies underpinned by a high level of global/regional cooperation and support.

Checklist for Climate Services Implementation

This checklist is for National Meteorological and Hydrological Services (NMHSs) to self-assess progress with respect to climate services implementation and identify areas where support is needed. The checklist refers to the Country-focused results based framework for WMO contribution to the GFCS approved by the 68th WMO Executive Council (abridged report pp. 82-92).

The checklist consists of "YES/NO" self-assessments as to the degree to which actions have been taken or outputs generated. These actions or outputs are grouped into the categories of:

- Governance
- Basic Systems
- User Interface
- Capacity Development
- Provision and Application of Climate Services
- Monitoring and Evaluation.

Within each grouping, actions or outputs are listed under the "Basic, Essential, Full, Advanced" headings. Ideally simultaneous actions will be taken in all categories, moving from left to right, from "Basic" to "Advanced".

Key next steps, where such actions or outputs have not been completed, may be candidates for further effort and/or technical support. Please review each section and select the option that applies by checking the respective box (double-click on the appropriate grey box, select "checked" as "Default value", then OK).

Objective: Institutional, technical, financial, and human resources mobilized for climate services planning, implementation and results monitoring targeting climate-sensitive national priorities

Governance

1. Identification of climate-sensitive national development priorities (Indicate if the following strategy/plans are available at national level):
   - NDC[8]: YES ☐ NO ☐
   - NAP9: YES ☐ NO ☐
   - National Development Policy or Strategy: YES ☐ NO ☐
   - National DRM10 Strategy YES ☐ NO ☐
   - National sectoral policies and strategies (e.g. food security, health, etc.): YES ☐ NO ☐

2. Capacity assessments of key stakeholders (including NMHSs and NHSs):
   - Identify key stakeholders for improving climate-related outcomes in priority sectors (UIPs11 focused on GFCS12 priorities: health, agriculture and food security, WRM13, energy, DRM): YES ☐ NO ☐
   - Identify key climatic factors of socio-economic significance at the national levels, establish baseline knowledge based on capacity assessments and co-define with stakeholders climate information needs for sectoral decision-making at national level: YES ☐ NO ☐
   - Identify feasible climate services for meeting priority needs and capacity needs/requirements for their development and delivery: YES ☐ NO ☐

3. National implementation plans/frameworks (e.g. NAPs or national action plans):
   - Verify status of and consult/support development and/or implementation of NAP and other plans listed in point 1 above reflecting priority needs: YES ☐ NO ☐
   - Co-develop national action plan for climate services (if appropriate, depending on status of/prospects for NAP) in response to priority needs: YES ☐ NO ☐
   - Establish institutional mandates for providing climate services as well as for using climate services, with the aim to mainstream efficient and well-informed climate risk management practices at all levels: YES ☐ NO ☐

4. Resources reviews of relevant on-going and planned partner projects:
   - Consult list of planned or on-going major adaptation (and mitigation) investment programmes (GEF14, GCF15, Adaptation Fund, PPCR16, development banks, RECs17): YES ☐ NO ☐

8 NDC - Nationally Determined Contribution to the Paris Agreement
9 NAP - National Adaptation Plan
10 DRM – Disaster risk management
11 UIP – User interface platform
12 GFCS – Global Framework for Climate Services
13 WRM – Water resource management
14 GEF – Global Environment Facility
15 GCF – Green Climate Fund
16 PPCR – Pilot Program for Climate Resilience
17 RECs – Regional Economic Commissions

- Jointly meet with national government Ministries/Departments and their counterpart(s) major international organizations (UNDP18, IFIs19, WFP20, FAO21, WHO22 etc.) as necessary to articulate NMHS needs to support development decisions: YES ☐ NO ☐
- Negotiate access to financing from on-going programmes and/or contribute to the development of new proposals to address identified needs: YES ☐ NO ☐

5. National planning, coordination, information sharing and monitoring structures:

Identify/establish/engage in an appropriate national governance mechanism to ensure coordination for climate services (there may already be one for NDCs, NAPs, DRM, etc.): YES ☐ NO ☐

Basic Systems (observing networks, data, data management, monitoring, and forecasting systems)

(Note: see Table 1 on categorization of NMHSs)

6. Adequate observing networks, data, data management, monitoring, and forecasting systems:

*Note: The capabilities are incremental by moving from left to right columns in the table (i.e. competencies related to the category "Essential" include the ones related to "Basic" etc.)

**Note: Section 6.a refers to the assessment of observing networks in the context of climate services

- Establish an internal management structure to integrate all basic systems into a functioning observing system:

  YES ☐ NO ☐
- Establish national requirements for observational needs to support climate services: YES ☐ NO ☐
- Perform gap analysis by matching observational needs against existing national capabilities: YES ☐ NO ☐
- Develop national observing strategy for weather and climate in order to address identified gaps YES ☐ NO ☐
- Aware of climate monitoring principles (Annex 3) YES ☐ NO ☐
- Adhere to climate monitoring principles (Annex 3) YES ☐ NO ☐

(a) Observing networks:

BASIC	ESSENTIAL	FULL	ADVANCED
• Operate and maintain adequate national observing systems, in support of the weather-	• Undertake to improve station density based on established and known national requirements:	• Adoption of long-term strategy for managing observing network and its	• Improve and strengthen national observing network based on national

18 UNDP – United Nations Development Programme
19 IFI – International Financial Institution
20 WFP – World Food Programme
21 FAO – United Nations Food and Agriculture Organization
22 WHO – World Health Organization

BASIC	ESSENTIAL	FULL	ADVANCED
related application areas of the WMO[23] Rolling Review of Requirements: YES ☐ NO ☐ • Develop complete inventory of existing national observing systems and their metadata by completing and updating national entries in OSCAR[24]/Surface: YES ☐ NO ☐	YES ☐ NO ☐ • Improve observations through compliance with WIGOS regulatory and guidance material: YES ☐ NO ☐ • Observing network delivers against ECVs[25]: YES ☐ NO ☐ • Formal partnership agreements established with external (non-NMHS) entities operating third party; observing networks under guidance on minimum set of requirements for use in local climate services: YES ☐ NO ☐	change, including relocation of stations, establishment of automated observations that meet climate observation requirements and standards, and protection of long-term observing stations: YES ☐ NO ☐	observing strategy, the relevant Regional WIGOS[26] Implementation Plan and the EGOS-IP[27]: YES ☐ NO ☐

23 WMO – World Meteorological Organization
24 OSCAR - Observing Systems Capability Analysis and Review Tool
25 ECVs - Essential Climate Variables
26 WIGOS - WMO Integrated Global Observing System
27 EGOS-IP - WMO Implementation Plan For The Evolution Of Global Observing Systems

(b) Data and data management:

BASIC	ESSENTIAL	FULL	ADVANCED
• Collect and store data and metadata in relational databases (OSCAR/Surface): YES ☐ NO ☐ • Conduct data rescue: YES ☐ NO ☐ • Apply quality control processes to climate data: YES ☐ NO ☐ • Conduct data management including weather forecasting and warnings, quality assurance/quality control, using Quality Management Framework principles: YES ☐ NO ☐ • Apply when necessary spatial temporal interpolation to ensure data continuity: YES ☐ NO ☐ • Create, archive and document climate datasets of the appropriate length, time resolution and units: YES ☐ NO ☐ • Assess climate data homogeneity and adjust inhomogeneous time series where possible: YES ☐ NO ☐ • Comply with the standards set and the recommendations made by WMO : YES ☐ NO ☐	• Historical as well as real time observations in the atmosphere, the oceans, over land and ice of the ECVs prepared by GCOS28 and partners for climate purposes, exchanged freely for use in RCCs29 for at least one Global Surface Network site: YES ☐ NO ☐ • Adopt well documented strategy including vision and operating manual for ensuring security, integrity, retention policy and technology migration for data archival process and systems: YES ☐ NO ☐ • Register data in WIS[30]: YES ☐ NO ☐	• Ensure all further observations are accumulated into time series: YES ☐ NO ☐ • Identify additional required data that can be accessed from regional and global sources: YES ☐ NO ☐ • Document and register rescued and non-rescued data in the WMO-GFCS I-DARE[31] portal: YES ☐ NO ☐ • Use Data Management Systems that are compliant with WMO Specifications as recommended by the Commission for Climatology: YES ☐ NO ☐	Identify and engage research to improve data availability: YES ☐ NO ☐

28 GCOS - Global Climate Observing System
29 RCC - Regional Climate Center
30 WIS - WMO Information System
31 I-DARE – International Data Rescue

(c) Monitoring:

BASIC	ESSENTIAL	FULL	ADVANCED
• Identify and retrieve adequate climate data from different sources to generate climate products: YES ☐ NO ☐ • Compute basic climate products, such as World Weather Records, Climatological Standard Normals , and other basic statistics i.e anomalies, standard deviations, percentiles contingency tables, etc.: YES ☐ NO ☐	• Compute Climate Indices and derived products for the monitoring of climate change and climate extremes using ETCCDI[32] (and other tools such as iTacs[33] for example) and NCMP[34] approach: YES ☐ NO ☐ • Generate generic monitoring products (i.e. drought monitoring, climate watch, etc.): YES ☐ NO ☐ • Compute sector-specific Climate Indices and other sector oriented climate products: YES ☐ NO ☐ • Create value-added products, such as graphics, maps and reports to explain climate characteristics and evolution, according to the needs of specific sectors such as health, agriculture, water and disaster management: YES ☐ NO ☐ • Comply with the standards set and the recommendations made by WMO: YES ☐ NO ☐ • Register in WIS operational climate monitoring data and products that are recommended by WMO for regional or global climate monitoring activities: YES ☐ NO ☐ • Apply QMS[35] principles: YES ☐ NO ☐	• Apply multi-variate statistical analysis to provide space-time distribution of climate patterns and identify statistical relationships across multiple variables: YES ☐ NO ☐ • Create integrated, continually updated data product time series, e.g. combining satellite observations and reanalysis with station data: YES ☐ NO ☐ • Produce gridded data sets based on peer-reviewed techniques and complying with WMO recommended practices: YES ☐ NO ☐ • Generate and manage consistent and systematic information on Extreme Weather and Climate Events complying with the WMO recommended practices: YES ☐ NO ☐	• Identify and engage research to improve monitoring and related products: YES ☐ NO ☐ • Publish regular, quality controlled authoritative information on the status of climate relevant to policy making for climate adaptation: YES ☐ NO ☐ • Simulation of past climate and generate model-based analysis and Reanalysis: YES ☐ NO ☐ • Statistical and dynamical down-scaling, using advanced empirical techniques and regional climate models: YES ☐ NO ☐ • Maintain, update regularly and make available for global access high quality peer-reviewed ECV datasets and document the underlying uncertainty assessment: YES ☐ NO ☐

32 ETCCDI - Expert Team on Climate Change Detection and Indices
33 iTacs - Interactive Tool for Analysis of the Climate System
34 NCMP - National Climate Monitoring Products
35 QMS – Quality management system

(d) Forecasting systems:

BASIC	ESSENTIAL	FULL	ADVANCED
• Participate in RCOFs[36]: YES ☐ NO ☐ • Disseminate climate outlooks provided by GPCs[37], RCCs and RCOFs: YES ☐ NO ☐	• Create value-added products, such as graphics, maps and reports to explain climate forecasts and climate model information: YES ☐ NO ☐ • Develop and/or provide monthly, seasonal and longer scale climate predictions, using both empirical and dynamical approaches: YES ☐ NO ☐ • Generate value-added forecast products for national scales based on RCC and GPC products: YES ☐ NO ☐ • Conduct and/or contribute to RCOF sessions: YES ☐ NO ☐ • Register forecasting products in WIS: YES ☐ NO ☐	• Generate sub-seasonal and seasonal forecast products: YES ☐ NO ☐ • Run climate models within the adequate domain and with adequate parametrization and scenarios: YES ☐ NO ☐ • Downscale climate prediction and projection products: YES ☐ NO ☐ • Interpret annual to decadal climate prediction products: YES ☐ NO ☐ • Coordinate RCOFs and NCOFs[38] and assist users in forecast interpretation: YES ☐ NO ☐	• Evaluate the performance of climate models output and quantify the associated uncertainties: YES ☐ NO ☐ • Run Global and/or Regional Climate Models (sub-seasonal to decadal and longer): YES ☐ NO ☐ • Locate, select and retrieve climate forecasts and climate models output generated by Regional Climate Centers, Global Producing Centers and other institutions to complement self-produced climate products: YES ☐ NO ☐ • Provide large scale data resources as input to modelling, research, applications, etc.: YES ☐ NO ☐ • Host GPCs/RCCs: YES ☐ NO ☐ • Guide/lead process improvement studies for RCOFs and NCOFs: YES ☐ NO ☐ • Create future climate projections using different scenarios: YES ☐ NO ☐

[36] RCOF – Regional Climate Outlook Forum
[37] GPC – Global Producing Center of WMO
[38] NCOF – National Climate Outlook Forum

BASIC	ESSENTIAL	FULL	ADVANCED
			• Apply statistical and geo-statistical analysis, including downscaling/ calibration, to monitor the spatial distribution and temporal evolution of model output: YES ☐ NO ☐ • Develop tailored products for decision support in priority sectors: YES ☐ NO ☐ • Apply recalibration procedures to model outputs: YES ☐ NO ☐ • Make skill assessments publicly available: YES ☐ NO ☐ • Identify and engage research to improve forecasting and related products: YES ☐ NO ☐

User Interface

7. Decision support tools and systems (identified, designed and improved, including any necessary research):

BASIC	ESSENTIAL	FULL	ADVANCED
Identify the top five most prominent sectoral users groups (list in the order of priority): • Interact with users, to meet requests (for basic climatology questions): YES ☐ NO ☐ • Assist users to interpret/use climate predictions and products: YES ☐ NO ☐ • Get periodic feedback from users on the usefulness and effectiveness of the information, products and services provided (including through NCOFs): YES ☐ NO ☐ • Establish effective relationships and communication channels with users: YES ☐ NO ☐	• Interact with users to identify their requirements for, and provide advice on, climate information and adequate and viable products for their application: YES ☐ NO ☐ • Conduct and evaluate user satisfaction on a regular basis (e.g. meetings, surveys): YES ☐ NO ☐ • Revise climate services and the means of communication based on user feedback: YES ☐ NO ☐ • Develop and apply in partnership with users applications to facilitate the understanding and use of existing climate products and services: YES ☐ NO ☐	• Co-design and co-develop products with users: YES ☐ NO ☐	• Work with sector-based research teams to develop applications models (e.g. to combine climate and agriculture information and produce food security knowledge products): YES ☐ NO ☐ • Jointly (with sector-based research teams) develop software and product suites for customized sector-specific climate products: YES ☐ NO ☐

Capacity development

8. Capacity development services:

Identify a source of and invest in capacity development assistance and training to support the capacity development needs emerging from the other activities (see section 4 in Governance):

- Neighbouring or other NMHS for basic education and cross-discipline operational training: YES ☐ NO ☐
- RTC[39], Education and/or Research Universities/institutions/organizations: YES ☐ NO ☐
- RCC: YES ☐ NO ☐
- GPC: YES ☐ NO ☐
- other: YES ☐ NO ☐

Involve users, if possible, from the other sectors in training events: YES ☐ NO ☐

Provision and Application of Climate Services

9. Decision-support products and services (established or strengthened):

BASIC	ESSENTIAL	FULL	ADVANCED
• Data services (unless prohibited under current mandate and legislation): YES ☐ NO ☐ • Access remote sensing and reanalysis products (i.e. EUMETCast): YES ☐ NO ☐ • Weather forecasting products: YES ☐ NO ☐ • Conduct basic climate diagnostics and climate analysis (staff will have some proficiency in climate statistics, or be able to reliably use statistical software (e.g. Climate Database Management System)): YES ☐ NO ☐ • Basic statistics (graphs, counts, etc.) on extremes, frequency of occurrence, spatial means for temperature (Max,	• Climate monitoring products: YES ☐ NO ☐ • Targeted dissemination of climate products to priority sectors (i.e. those based on data; regional and national climate monitoring products if available; seasonal outlooks provided by RCOFs and RCCs): YES ☐ NO ☐ • Generic seasonal forecasts: YES ☐ NO ☐ • Update/Improve/Develop products and services based on users' feedback and requirements:	• Sub-seasonal forecasts: YES ☐ NO ☐ • Tailoring of products received from RCCS and in some cases GPCs for national applications: YES ☐ NO ☐ • Tailored seasonal forecasts (to address user needs): YES ☐ NO ☐	• Climate change projections: YES ☐ NO ☐ • Helpdesk function: YES ☐ NO ☐ • Provide products that can directly be plugged-in decision support tools including for policy development: YES ☐ NO ☐ • Diversified channels of communication used to disseminate climate products (e.g. radio, social media): YES ☐ NO ☐

[39] RTC - Regional Training Centre

BASIC	ESSENTIAL	FULL	ADVANCED
Min, Mean), precipitation, and possibly relative humidity, evapotranspiration, thunder days, sunshine duration, cyclones, etc., climatological normal: YES ☐ NO ☐ • Regularly conduct NCOF sessions: YES ☐ NO ☐ • Conduct climate watch programmes and disseminate early warnings: YES ☐ NO ☐	YES ☐ NO ☐		• Provide products relevant to neighbouring or other countries: YES ☐ NO ☐

Monitoring and Evaluation

10. Monitoring of benefits resulting from climate services:

BASIC	ESSENTIAL	FULL	ADVANCED
• Identify climate sensitive user sector outcomes and associated variables to measure them i.e. disaster losses, crop yields, hydropower: YES ☐ NO ☐ • Identify sources of this information: YES ☐ NO ☐	• Establish ongoing monitoring systems for documenting user outcomes: YES ☐ NO ☐ • Establish baselines of sectoral outcomes for continuous evaluation of climate services: YES ☐ NO ☐	• Socio-economic analysis of cost-benefits of climate services conducted in collaboration with users: YES ☐ NO ☐	• Investment plans of climate sensitive sectors based on results of socio-economic analysis of cost-benefits of climate services: YES ☐ NO ☐ • Policy response as an outcome of the results of the socio-economic analysis of cost-benefits of climate services: YES ☐ NO ☐

1. **Table 1. Categorization of NMHSs**
(Source: Commission for Climatology Guidelines for NMHSs on capacity development for climate services)

Level of service	Weather servicers	Climate services	Hydrology services	Description of capacity needed to achieve service level
Category 1- Basic	➢ Weather observations ➢ Weather Data Management ➢ Interaction with users of weather data and products	➢ Climate observations ➢ Climate Data Management ➢ Interaction with users of weather data and products	➢ Hydrological observations ➢ Hydrological data management ➢ Interaction with users of hydrology data and products	➢ Small network of quality controlled observations ➢ Basic data-processing, archiving and communication systems ➢ Little or no backup / offsite storage, or contingency options ➢ Staff: observers and some meteorologists trained to Basic Instruction Package (BIP) ➢ No 24 /7 operation ➢ Rudimentary Quality Management System ➢ No research and development
Category 2- Essential	➢ Medium-range (synoptic scale) forecasts and warnings ➢ Established links with media and disaster risk reduction (DRR) communities	➢ Seasonal Climate outlooks ➢ Climate monitoring	➢ Hydrological data products for design and operation of water supply structures ➢ Water level and flow monitoring ➢ Short-term flow forecasts (low flows) ➢ Flood forecasting	➢ Able to take and integrate observations from other parties ➢ Well-established protocols for emergencies, backup of data and minimum offsite facilities ➢ Staff: observers and meteorologists trained to BIP standards ➢ 24/7 operation. ➢ Well established quality management system ➢ Able to access most numerical weather prediction data/products from other centres ➢ Small research and development unit ➢ Some partnerships as junior members
Category 3- Full	➢ Specialized weather products for a wide range of sectors ➢ Well integrated into DRR communities and mature links with media	➢ Specialized climate products ➢ Decadal climate prediction ➢ Long-term climate projections ➢	➢ Seasonal stream flow outlooks ➢ Specialized hydrology products	➢ Advanced observation equipment ➢ Ability to run its own numerical prediction suite ➢ Research and development unit ➢ Well educated/trained staff ➢ Own training group ➢ Developed library and information services ➢ Active partnerships with NMHSs taking a leading role
Category 4- Advanced	➢ Customized weather products ➢ Weather application tools.	➢ Customized climate products ➢ Climate application tools	➢ Customized hydrology products ➢ Hydrology application tools	➢ Advanced observations ➢ Leading Research and development team ➢ Well-developed Education and training Unit

3. List of acronyms

DRM	Disaster Risk Management
ECV	Essential Climate Variables
EGOS-IP	WMO Implementation Plan for the Evolution of Global Observing Systems
ETCCDI	Expert Team on Climate Change Detection and Indices
FAO	United Nations Food and Agriculture Organization
GCF	Green Climate Fun
GCOS	Global Climate Observing System
GEF	Global Environment Facility
GFCS	Global Framework for Climate Services
GPC	Global Producing Centre of WMO
I-DARE	International Data Rescue
IFI	International Financial Institutions
iTACS	Interactive Tool for Analysis of the Climate System
NAP	National Adaptation Plan
NCMP	National Climate Monitoring Products
NDC	Nationally Determined Contribution to the Paris Agreement
NMHS	National Meteorological and Hydrological Service
OSCAR	Observing Systems Capability Analysis and Review Tool
PPCR	Pilot Program for Climate Resilience
QMS	Quality Management System
RCC	Regional Climate Center of WMO
RCOF	Regional Climate Outlook Forum
RECs	Regional Economic Commissions
RTC	Regional Training Center
UIP	User Interface Platform
UNDP	United Nations Development Programme
WFP	World Food Programme
WHO	World Health Organization
WIGOS	WMO Integrated Global Observing System
WIS	WMO Information System
WMO	World Meteorological Organization
WRM	Water Resource Management

5. Global Climate Observing System climate monitoring principles

(Revised Reporting Guidelines as agreed by the UNFCCC at Bali, December 2007, decision 11/CP.13)
Effective monitoring systems for climate should adhere to the following principles:

(a) The impact of new systems or changes to existing systems should be assessed prior to implementation;
(b) A suitable period of overlap for new and old observing systems is required;
(c) The details and history of local conditions, instruments, operating procedures, data processing algorithms and other factors pertinent to interpreting data (i.e. metadata) should be documented and treated with the same care as the data themselves;
(d) The quality and homogeneity of data should be regularly assessed as a part of routine operations;
(e) Consideration of the needs for environmental and climate-monitoring products and assessments, such as Intergovernmental Panel on Climate Change assessments, should be integrated into national, regional and global observing priorities;
(f) Operation of historically-uninterrupted stations and observing systems should be maintained;
(g) High priority for additional observations should be focused on data-poor regions, poorly-observed parameters, regions sensitive to change, and key measurements with inadequate temporal resolution;
(h) Long-term requirements, including appropriate sampling frequencies, should be specified to network designers, operators and instrument engineers at the outset of system design and implementation;
(i) The conversion of research observing systems to long-term operations in a carefully-planned manner should be promoted;
(j) Data management systems that facilitate access, use and interpretation of data and products should be included as essential elements of climate monitoring systems.

Furthermore, operators of satellite systems for monitoring climate need to:

(a) Take steps to make radiance calibration, calibration-monitoring and satellite-to-satellite cross-calibration of the full operational constellation a part of the operational satellite system;
(b) Take steps to sample the Earth system in such a way that climate-relevant (diurnal, seasonal, and long-term interannual) changes can be resolved.

Thus satellite systems for climate monitoring should adhere to the following specific principles:

(a) Constant sampling within the diurnal cycle (minimizing the effects of orbital decay and orbit drift) should be maintained;
(b) A suitable period of overlap for new and old satellite systems should be ensured for a period adequate to determine inter-satellite biases and maintain the homogeneity and consistency of time-series observations;
(c) Continuity of satellite measurements (i.e. elimination of gaps in the long-term record) through appropriate launch and orbital strategies should be ensured;
(d) Rigorous pre-launch instrument characterization and calibration, including radiance confirmation against an international radiance scale provided by a national metrology institute, should be ensured;
(e) On-board calibration adequate for climate system observations should be ensured and associated instrument characteristics monitored;
(f) Operational production of priority climate products should be sustained and peer-reviewed new products should be introduced as appropriate;
(g) Data systems needed to facilitate user access to climate products, metadata and raw data, including key data for delayed-mode analysis, should be established and maintained;
(h) Use of functioning baseline instruments that meet the calibration and stability requirements stated above should be maintained for as long as possible, even when these exist on decommissioned satellites;
(i) Complementary in situ baseline observations for satellite measurements should be maintained through appropriate activities and cooperation;
(j) Random errors and time-dependent biases in satellite observations and derived products should be identified.

6. References

1. High Level Task Force Report - Climate Knowledge for Action: A Global Framework for Climate Services: http://library.wmo.int/pmb_ged/wmo_1065_en.pdf
2. WMO Capacity development strategy and implementation plan: https://www.wmo.int/pages/prog/dra/CDS.html
3. Commission for Climatology Guidelines for NMHSs on Capacity Development for climate services (ref: Table 2, p 31)

PART IV: ENDORSEMENT BY GOVERNMENTS AND CERTIFICATION BY THE IMPLEMENTING ENTITY

1 Record of Endorsement on behalf of the Governments

Gladys Santis, Adaptation Officer, Ministry of Environment, Chile	Date: *April 2nd, 2019*
David Felipe Olarte Amaya, Head International Affairs Bureau, Ministry of Environmental and Social Development, Colombia	Date: *April 9th, 2019*
Rosa Morales Saravia, Head of the General Directorate of Climate Change and Desertification, Ministry of Environment, Peru	Date: *April 12th, 2019*

2 Implementing Entity Certification

I certify that this proposal has been prepared in accordance with guidelines provided by the Adaptation Fund Board, and prevailing National Development and Adaptation Plans in Chile, Colombia and Peru and subject to the approval by the Adaptation Fund Board, commit to implementing the project/programme in compliance with the Environmental and Social Policy of the Adaptation Fund and on the understanding that the Implementing Entity will be fully (legally and financially) responsible for the implementation of this project/programme.	
Signed: Jean-Paul Gaudechoux Implementing Entity Coordinator	
Date: April 15th, 2019	Tel. and email:41 22 730 8311 jpgaudechoux@wmo.int
Project Contact Person: Jose Luis Camacho	
Tel. And Email: 41 22 730 8357 / jcamacho@wmo.int	

ADAPTATION FUND

Ministerio del Medio Ambiente
Gobierno de Chile

CHILE LO HACEMOS TODOS

Letter of Endorsement by Government

April 2nd, 2019

To: **The Adaptation Fund Board**
c/o Adaptation Fund Board Secretariat
Email: Secretariat@Adaptation-Fund.org
Fax: 202 522 3240/5

Subject: Endorsement for Enhancing Adaptive Capacity of Andean Communities through Climate Services (ENANDES)

In my capacity as designated authority for the Adaptation Fund in Chile, I confirm that the above regional project/programme proposal is in accordance with the government's national priorities in implementing adaptation activities to reduce adverse impacts of, and risks, posed by climate change in the country.

Accordingly, I am pleased to endorse the above project/programme proposal with support from the Adaptation Fund. If approved, the project/programme will be implemented by the World Meteorological Organization (WMO) and executed by the National Meteorological and Hydrological Services of: Colombia (IDEAM), Chile (DMC) and Peru (SENAMHI), and the WMO regional Climate Centre for Western South America (CIIFEN).

Sincerely,

MINISTERIO DEL MEDIO AMBIENTE * CAMBIO CLIMATICO *

Gladys Santis
Adaptation Officer
Ministry of Environment
Government of Chile

ADAPTATION FUND

El ambiente es de todos | Minambiente

Letter of Endorsement by Government

April 9th, 2019

To: The Adaptation Fund Board
c/o Adaptation Fund Board Secretariat
Email: Secretariat@Adaptation-Fund.org
Fax: 202 522 3240/5

Subject: Endorsement for "Enhancing adaptive Capacity of adaptation of the Communities through Climate Services (ENANDES)

In my capacity as designated authority for the Adaptation Fund in Colombia, I confirm that the above regional project/programme proposal is in accordance with the government's national priorities in implementing adaptation activities to reduce adverse impacts of, and risks, posed by climate change in the country.

Accordingly, I am pleased to endorse the above project/programme proposal with support from the Adaptation Fund. If approved, the project/programme will be implemented by the World Meteorological Organization (WMO) and executed by the National Meteorological and Hydrological Service of: Colombia (IDEAM), Chile and Peru.

Sincerely,

David Felipe Olarte Amaya
Head of the International Affairs Bureau
Ministry of Environment and Social Development
Government of Colombia

Review: Jose Francisco Charry