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# PERU CLIMATE CHANGE VULNERABILITY AND ADAPTATION DESKTOP STUDY



December 22, 2011

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**PHOTO:**

**Community and Rio Yanamito (on left) and Río Santa (at middle right), Glen Anderson**

IQC Contract No. AID-EPP-I-00-04-00024

Task Order No. AID-OAA-TO-11-00040

# PERU CLIMATE CHANGE VULNERABILITY AND ADAPTATION DESKTOP STUDY

WRITTEN FOR USAID UNDER THE CLIMATE CHANGE RESILIENT  
DEVELOPMENT TASK ORDER

***December 22, 2011***



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## ACRONYMS

ANA	Autoridad Nacional del Agua (National Water Authority)
CONAM	Consejo Nacional del Ambiente <sup>1</sup> (National Environmental Council)
DGCCDRH	Dirección General de Cambio Climático, Desertificación y Recursos Hídricos (General Directorate for Climate Change, Desertification, and Water Resources)
EGAT	Bureau for Economic Growth, Agriculture and Trade
ENSO	El Niño Southern Oscillation
FONAM	Fondo Nacional del Ambiente (National Environment Fund)
GEF	Global Environmental Facility
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GLOF	Glacial Lake Outburst Flood
GOP	Government of Peru
ICAA II	Initiative for the Conservation for the Andean Amazon
IFAD	International Fund for Agricultural Development
INDECI	Instituto Nacional de Defensa Civil (National Institute for Civil Defense)
IPCC	Intergovernmental Panel on Climate Change
IRG	International Resources Group
m.a.s.l.	meters above sea level
MEF	Ministerio de Economía y Finanzas (Ministry of Economy and Finance)
MINAM	Ministerio del Ambiente (Ministry of Environment)
NGO	Non-governmental Organization
PROCLIM	Peruvian Climate Change and Air Quality Program
PAMA	Environmental Management and Adaptation/Compliance Program
PACC	Program on Climate Change Adaptation in Peru
PENTUR	Plan Estratégico Nacional de Turismo (National Strategic Plan of Tourism of Peru)
PRAA	Adaptation to Impacts of Rapid Glacier Retreat in the Tropical Andes Project

REDD+	Reduced Emissions from Deforestation and Forest Degradation
SDC	Swiss Agency for Development and Cooperation
SENAMHI	Servicio Nacional de Meteorología e Hidrología del Perú (National Meteorology and Hydrology Service)
SINANPE	Servicio Nacional de Áreas Naturales Protegidas por el Estado (National Protected Areas System)
SNC	Second National Communication
TMI	The Mountain Institute
UNDP	United National Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USD	US Dollars

## **1. INTRODUCTION**

### **1.1 BACKGROUND**

Peru is the third largest country in South America, covering 1,285,000 square km. Assessing climate trends and risk is complicated by the heterogeneous nature of Peru's climate. Along the coast, the north receives more precipitation than the desert south. Mountain ranges contain valleys and plateaus that create micro-climates with varying degrees of precipitation and temperatures, and the eastern Amazon Basin receives heavy average annual precipitation. Given the variety of climate conditions and resources, each climate zone is characterized by different climate regimes and expected to be affected by climate variability and change in different ways.

Climate change trends in Peru include rising temperatures, extreme temperature fluctuations, changing rainfall patterns, sea level rise, and an increasing rate of glacier melt in the Andes. Peru is highly vulnerable to these changes, as the majority of Peruvians live in water-sensitive areas, work in resource-dependent sectors such as agriculture or fishing, or exist in or on the margins of poverty.

The broad goal of climate change adaptation is to create societies that are resilient to adverse climate change impacts and have the ability to rise to both the challenges and the opportunities presented by a changing climate. The United States Agency for International Development's (USAID) activities to support adaptation aim to be sensitive to development priorities, address key vulnerabilities to climate change and variability, and focus on measures that are timely and likely to be successful in reducing vulnerabilities. This desktop study constitutes the first component of an assessment being undertaken by USAID/Peru with support from the Bureau for Economic Growth, Agriculture and Trade's (EGAT) Global Climate Change team. USAID's adaptation investments will assist Peru to identify and reduce its vulnerability to such climate change impacts, in order to continue to achieve its development objectives<sup>2</sup>.

### **1.2 PURPOSE OF THE PERU CLIMATE CHANGE ADAPTATION ASSESSMENT REPORT**

This report is intended to inform the in-country assessment process for possible future USAID/Peru-funded adaptation activities addressing climate change challenges. The report may also serve as a model for other USAID Missions that are beginning similar processes, by demonstrating what kinds of knowledge sources to review and what level of detail is appropriate and useful for project planning and design. It may also help Missions to understand the kinds of methodologies and approaches to use to set priorities and to focus on particular sectors or gaps to enhance their ability to integrate climate considerations and respond to the challenges posed by climate variability and change.

### **1.3 APPROACH AND METHODS**

As a quick response desk study, International Resources Group's (IRG) approach consisted of the following steps:

- Assess particular Peruvian sectors, locations, and populations most vulnerable to climate change using existing documents and databases.

- Identify activities of bilateral and multilateral donors, international Non-governmental Organizations (NGOs), and the Government of Peru (GOP) with which USAID might collaborate or complement with its own activities.

## 1.4 ROADMAP TO THE REPORT

The remainder of this desktop study is organized into five chapters. Chapter 2 provides the development context, including key economic sectors, social and demographic trends, and critical ecosystems in Peru. Chapter 3 discusses Peru's vulnerability to climate change, and important impacts of concern. This chapter also discusses valued sectors in Peru, and how they might be impacted by projected changes in climate.

Chapter 4 discusses adaptation planning and priorities in Peru, including activities being undertaken by the Government of Peru as well as the donor community. Chapter 5 highlights important gaps in adaptation activities. And finally, Chapter 6 makes recommendations for adaptation activities, broken down by overall recommendations and specific sectors.

## 2. DEVELOPMENT CONTEXT

Consistent with USAID's evolving approach for assessing climate concerns in terms of development objectives, we first characterize key development sectors, the social context for development, ecological resources, and non-climate stressors that constrain the achievement of development goals in Peru.

### 2.1 ECONOMIC - KEY SECTORS IN TERMS OF GROSS DOMESTIC PRODUCT, EMPLOYMENT, PRIORITIES FOR ECONOMIC GROWTH

Peru's economy has experienced strong growth over the past ten years; in 2010, gross domestic product (GDP) grew by 8.8 percent<sup>3</sup>, with continued growth projected for the medium term<sup>4</sup>. The foundations of economic growth rest on its most productive sectors: manufacturing and construction, agriculture, and mining. Despite their strong performance of late, these sectors are highly dependent on international prices and demand, and the continued health and availability of natural resources. To the extent that these international and natural forces are affected by climate change, so too do they affect Peru's economy.

**Manufacturing and construction.** It is estimated that manufacturing and construction account for 21.4 percent of GDP<sup>5</sup>. Peruvian industry primarily consists of manufacturing non-primary, minimally processed clothing and crafts. Although manufacturing makes up the single largest piece of the economy, the construction sector is the largest contributor to Peru's economic growth at this time, doubling its contribution to GDP from 2005 to 2008<sup>6</sup>. Demand for new construction in growing urban areas such as Lima is fueling this growth.

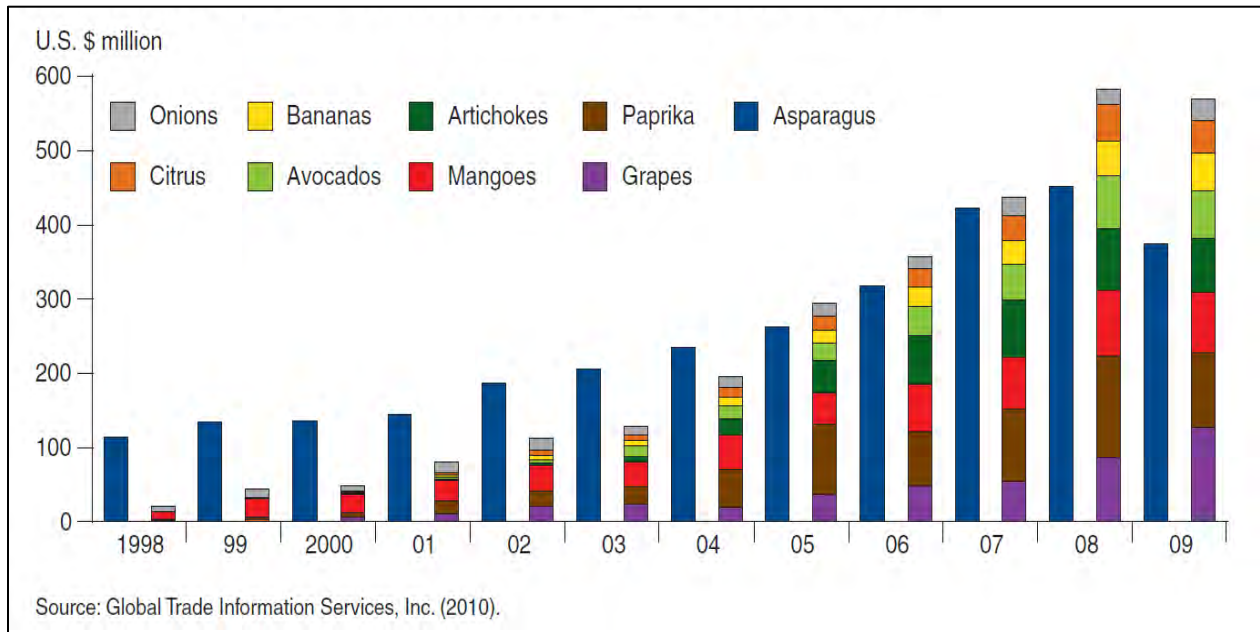
**Agriculture.** Agriculture is arguably the most important sector in Peru's economy. Although agriculture (including livestock) makes up only 7 percent of GDP, 23.3 percent of the Economically Active Population<sup>7</sup> in Peru is working in agriculture<sup>8</sup>. Agriculture in Peru falls into three main



categories: extensive agriculture (farming large areas of land with little labor by applying mechanized cultivation techniques and maximizing inputs such as fertilizers and pesticides; most products are grown for export), small scale agriculture (much of these crops are sold in domestic markets), and subsistence farming<sup>9</sup>. Over 70 percent of farms are smaller than 3.1 acres in size<sup>10</sup>.

Approximately 17 percent of Peru’s total land is used for agriculture, of which 28 percent is irrigated<sup>11</sup>. The narrow coastal zone to the west of the Andes is Peru’s most productive agricultural zone, and much of the export crops (sugarcane, cotton, rice, asparagus, grapes, artichokes) are grown in this area using extensive agriculture methods, while more traditional crops for domestic consumption (potatoes, coca, quinoa) are produced in upland regions on smaller farms. Exhibit 1 below shows the growth in export value of selected fruits and vegetables. Export crops are grown on approximately three percent of the agriculture land under production; 31 percent of agricultural land supports crops for national markets<sup>12</sup>.

**Exhibit 1. Growth in the value of selected Peruvian fruit and vegetable exports, 1998-2009<sup>13</sup>**



Aside from the difference in size, the major difference between export-oriented and domestic agriculture in Peru is the way that it is carried out. Coastal farms tend to grow water-intensive crops for export in desert conditions, using extensive agriculture methods that include mechanized irrigation. Agriculture in the highlands is mostly traditional crops that are rainfed<sup>14</sup>.

The importance of agriculture in Peru extends beyond its direct contribution to GDP. Subsistence farming is critical to the rural areas of Peru, where poverty is most extreme and food insecurity is chronic<sup>15</sup>. However, these rural agriculture communities have been poorly served by transportation and sanitation infrastructure, and rural poverty rates among those earning a living in the agriculture sector is higher than those in the non-agriculture sector (80 percent vs. 60 percent)<sup>16</sup>.

**Mining<sup>17</sup>.** Peru is the world leader in the production of silver, and a major producer of gold, tin, copper, lead, and zinc. Mineral exports are important to the country's economy. The mining sector

has been growing steadily over the last eight years and in 2009, mining accounted for 61 percent of Peru's export revenue<sup>18</sup> and over 5 percent of GDP<sup>19</sup>. Mining claims have increased by more than 18 million hectares since 1992 (now estimated at more than 22 million hectares)<sup>20</sup>. Despite this dramatic increase, only 10.5 percent of the country's land area has been granted to mining activities and it is believed that much of the available resources have not yet been exploited<sup>21</sup>.

There has been increased pressure through greater foreign investment and export demand to expand mineral exploration in Peru. In 2009, mining investment in Peru was almost 2.8 billion US Dollars (USD), and committed investment in the sector for 2009-2016 is worth USD 35.5 billion<sup>22</sup>. Two of Peru's gold mines, Yanacocha and Pierina, are among the most productive and profitable gold mines in the world. Peru has an estimated 21 million fine ounces of gold reserves in mines currently under operation and 42 million fine metric tons of copper reserves.

With the increase in mining activity comes an increase in social conflict in Peru between local communities and mining companies. In October 2011, the Defensoría del Pueblo (the Peru Ombudsman Office in charge of tracking and mediating disputes) reported 154 active social disputes on file; 103 of them related to environmental concerns. Of those 103 cases, approximately 80 were related to mining activities<sup>23</sup>. Complaints take the form of labor disputes, land rights, resource use and contamination. Mining exacerbates non-climate stressors, and local communities are often torn between short term economics benefits of mining activity and long term costs to the environment and human health. Some positive impacts included increased infrastructure, employment opportunities, access to formal education, and health care.

Mining is not a labor-intensive activity, creating few jobs and demanding huge investments for each job created. Nevertheless, it represents one of the few money-making activities in the Peruvian highlands, particularly in areas higher than 12,000 feet above sea level where most mining operations are located. As mining practices become more mechanized, they require less and less labor; the mineral sector employed 125,603 people in 2009 compared with 127,232 in 2008, not including informal miners, which are estimated at 60,000<sup>24</sup>. Each community must weigh the economic benefits of mining with the cost of degraded water and land resources.

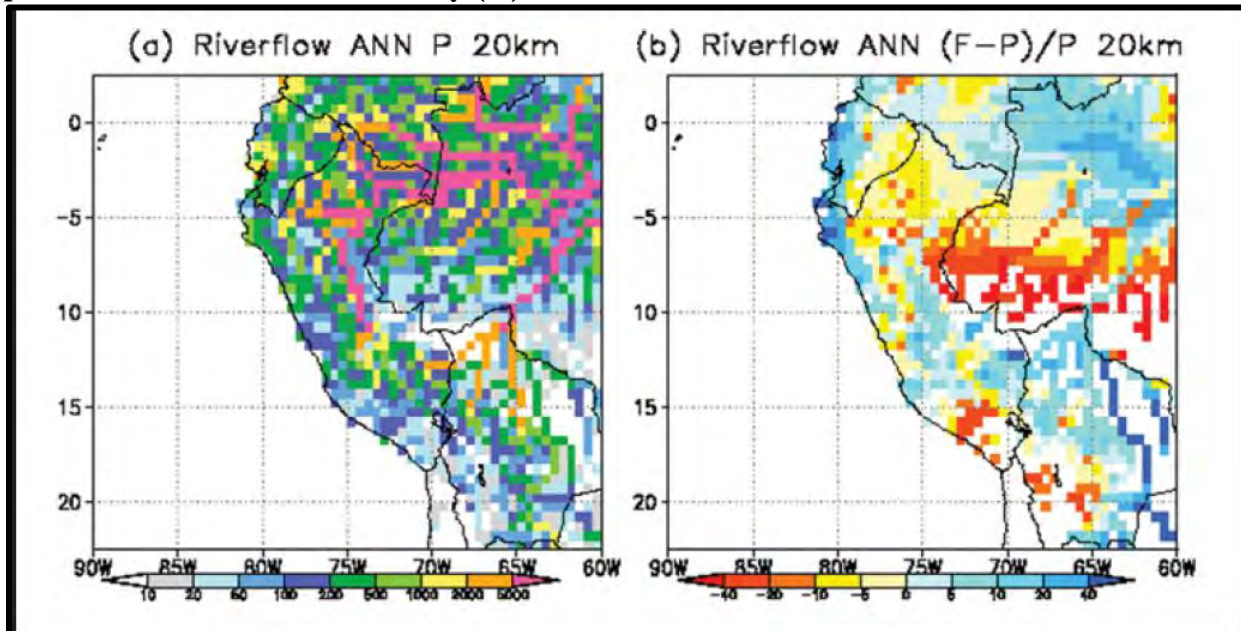
**Fisheries.** The Humboldt Current brings nutrient-rich cold water to the coastal zone off of Peru, feeding an important marine ecosystem, home to 736 known fish species<sup>25</sup>. Of these species, the anchovy is the most important to Peru's economy: measured in volume harvested, the Peruvian anchovy is the world's largest fishery<sup>26</sup>. Much of the anchovy catch is used to produce fishmeal and fish oil, worth just over USD 2 billion in exports in 2008<sup>27</sup>. Fishing represents 0.5 percent of Peru's GDP<sup>28</sup>, and anchovies make up about 75 percent of this figure<sup>29</sup>. The Ministry of Production regulates the fishing industry, and has targeted aquaculture development as a near term (2010 – 2021) goal<sup>30</sup>. Scallops and shrimp are most commonly cultivated along the coast of Peru.

**Energy and electricity sector.** Between 2006 and 2009, 50 percent of Peru's electricity was produced from hydropower<sup>31</sup>. Despite this great renewable energy resource, the country remains highly dependent on hydrocarbons, and there was a significant increase in the use of natural and liquefied gas for power generation between 2001 and 2008, from 5 percent to 29 percent<sup>32</sup>. Nevertheless, Peru would like to expand renewable energy resources to meet the growing demand for electricity, which is expected to expand by 100 percent between 2010 and 2030<sup>33</sup>. The Ministry of Economy and Finance has accepted a loan from the Inter-American Development Bank to

support the development of a sustainable energy matrix, which will rely heavily on hydropower and natural gas.

With anticipated growth in energy demand, hydropower can be an effective option for minimizing the increase in greenhouse gas (GHG) emissions associated with fossil fuels. At the same time, this greater reliance on renewable energy elevates the importance of managing water resources effectively, given the high vulnerability of water resources to climate change (see Section 3). More than 80 percent of Peru’s hydropower is generated in three river basins, with the Cañon del Pato accounting for nearly one-third of hydropower production<sup>34</sup> and fifty percent of the hydropower generated in Peru produced in the Mantaro and Urubamba River Basins. All of these river basins are fed by glaciers that provide a substantial share of dry season flow<sup>35</sup>. As these glaciers retreat, and runoff from them decreases, the generation capacity is reduced<sup>36</sup>. Exhibit 2 below shows current annual river flows and projected change in flows at the end of this century<sup>37</sup>. SENHAMI also closely monitors precipitation of major rivers in Peru, and publishes their predictions online<sup>38</sup>.

**Exhibit 2. Changes in river flows a) current annual flows (mm) and b) change between the present and the end of the century (%)**



Source: Figure generated under the Memorandum of Understanding (MOU) between the MRI and the World Bank.

Note: Picture a) presents the absolute annual flow, and therefore the scale is in mm. Picture b) presents the change, and the scale is in percentage.

**Tourism.** Tourism is an increasingly important piece of Peru’s economy. The Ministry of Tourism and International Trade estimates that tourism generated USD 274.1 million in 2010, an increase of 12.4 percent from 2009<sup>39</sup>. At the end of 2010, international arrivals were reported at 2,299,000, 7.4 percent more than recorded in 2009<sup>40</sup>. Tourism activities focus on the natural resources and cultural heritage of Peru, such as Lake Titicaca, Machu Picchu, Colca Valley, the Amazon River, and Nazca Lines. Tourism is impacted by infrastructure (including transportation, sanitation, and electricity),

services, weather, governance, and access and availability of sites. The National Strategic Plan of Tourism of Peru (PENTUR) 2008-2018, is the guiding document for the development and integration of resources to promote tourism in Peru. PENTUR tries to balance conservation of Peru's culture and natural resources while encouraging tourism, which has become an important part of the national economy<sup>41</sup>.

## **2.2 SOCIAL – DEMOGRAPHICS, TRENDS, PRIORITIES FOR HUMAN DEVELOPMENT**

Peru's population is just over 29 million, with 72 percent living in urban areas, mostly concentrated along the desert coast<sup>42</sup> (Peru's largest Departments are Lima, La Libertad, and Piura<sup>43</sup>). Peru's population growth is moderate at just over 1 percent, and the average life expectancy at birth is 74 years. Although literacy rates overall are 85 percent for females and 95 percent for males 15 years of age and older<sup>44</sup>, the differences among geographic regions tells a different story. Illiteracy rates in 2010 were only 2.9 percent in Lima Metropolitana, but the Sierra's illiteracy rate was 13.3 percent<sup>45</sup>.

Peru's poverty rate is high, with 35 percent of the population living below the poverty line, and indigenous and Afro-Peruvian populations remain marginalized despite the positive economic growth experienced by the country as a whole<sup>46</sup>. The highest rates of poverty occur in the rural Selva and Sierra regions of Peru (57.4 percent and 65.6 percent, respectively)<sup>47</sup>.

The concentration of Peru's population along the coast places additional burden on the infrastructure, water resources, and limited arable land there. Lima is the second largest desert city after Cairo and, while the Nile transports 2800 cubic meters of water per second in Egypt, the Rimac River in Peru does not even reach 1 percent of this flow. In 2007, only 88 percent of Peru's urban population had access to improved drinking water<sup>48</sup>. The city of Lima treats only about 9 percent of its wastewater, and discharges the remainder into the Pacific Ocean<sup>49</sup>. Growing urban populations require water and sanitation services, roads, and buildings, all of which become more difficult to provide and maintain as sea levels rise, potable water diminishes, and erosion and natural weather and geologic events undermine infrastructure.

Although the majority of Peru's population is located along the coast, urban areas in the selva (rainforest) and sierra are seeing the greatest rate of population growth. In the years between the 1993 and 2007 national census, the Departments of Madre de Dios and Ucayali saw the greatest rate of urbanization (109 percent and 58.9 percent, respectively), followed by Ayacucho and Puno in the sierra (50.1 and 48.8 percent)<sup>50</sup>. Although it is difficult to know the driver behind these increases, advancements in transportation, communication, and employment opportunities may be credited with this growth.

The move to an urban culture is also eroding the traditional culture, practices, and languages of Peru. With the loss of this knowledge is the potential loss of traditional coping and adaptation measures in response to climate change, including adaptation of land use, crop selection, agriculture methods, and building techniques.

## 2.3 ECOLOGICAL – CRITICAL ECOSYSTEMS, GEOGRAPHY, PRIORITIES FOR SUSTAINABLE ECOLOGICAL MANAGEMENT AND CONSERVATION

**Coastal zone.** Peru has 2,414 km of coast line<sup>51</sup> that is a desert with 52 small river valleys that flow from the dry mountains to the east<sup>52</sup>. Although very dry, humidity can reach up to 91 percent in the winter months (June-September), particularly in areas of the desert hills where moisture-rich fog creates vegetative oases (*lomas*)<sup>53</sup>. The coastal region receives only 2900 cubic meters of water per person per year (versus 643,000 cubic meters per person per year in the selva) and supports 59 percent of the population (versus 10 percent in the selva). There are more than 1,200 native species in the coastal zone; soils are of a very loose structure and are generally sandy<sup>54</sup>.

Although fish are important to the economy and culture of Peru, the coastal zone contributes much more to the economy through cultivated agriculture. The most agriculturally productive area is the North Coast, and much of the export crops are grown here. These crops are generally grown on plantation-style farms, and are heavily irrigated. In Ica, a coastal department that grows much of the export-oriented asparagus, one of the largest underground aquifers along the Peruvian coast is being rapidly depleted. If the pace of withdrawals continues, estimates are that the aquifer could be depleted by 2013<sup>55</sup>. Increasing water demand for industrial agriculture and growing populations are exacerbating this and similar situations all along the coast.

Irrigation boards and water-management districts exist to enforce water rights and customs, but the system is biased toward coastal agriculture. In addition to improving water laws and focusing on water-use efficiencies, there is an opportunity to maximize the benefit of naturally-occurring ecology. The Nature Conservancy is looking at how the fog-catching vegetation in zones where *lomas* occur can be restored, protected, and better utilized to provide water along the coast.

**Mountains.** The Andes mountain range is the backbone of Peru, regulating its climate, and home to glaciers and rivers that provide freshwater to the majority of the population of Peru. Between the dry Pacific to the west and jungle to the east lie the populous intermontane valleys and *altiplano* plateaus where approximately 36 percent of Peru's population lives<sup>56</sup>. Small indigenous communities are the norm in the mountains. Although often impoverished, these communities hold a wealth of traditional knowledge and agricultural techniques that may be critical to adapting to climate change.

Two parallel ranges make up the Andes – the Cordillera Occidental and Cordillera Oriental – with forty peaks above 6,000 meters high<sup>57</sup>. For good reason, the glaciers in Peru receive a great deal of attention. Peru has more than 70 percent of the world's tropical glaciers, and their retreat (e.g., an estimated 22.5 percent recession of glaciers in the Cordillera Blanca mountain range between 1975 and 2005<sup>58</sup>) has devastating consequences for water supply, flooding and a possible increase in seismic activity.

A unique mountain ecosystem is the *páramo*, an ecosystem of plants between the high altitude forest line and the snow line that trap water and fog. *Páramos* receive between 500 – 3000 mm of rain per year, and the retention of this precipitation is facilitated by characteristic warm days and cold nights<sup>59</sup>. Similar to the *páramo* is the *puna* ecosystem in Peru, which is drier than the *páramo*, but also serves the important role of capturing and storing water.

The upward movement of agriculture, deforestation, mining and industry, and road building are affecting mountain ecosystems. Soil erosion and water contamination are compounding the negative effects of melting glaciers and changing temperature and precipitation patterns due to climate change.

**Forests.** Covering almost a million square kilometers, Peru is home to the second-greatest share of Amazonia and the fifth-largest contiguous area of rainforest in the world. This rainforest makes up 74 percent of the country's area and 14 percent of Amazonia as a whole. Under Peru's National Protected Areas System (SINANPE), 19 million hectares of forests are under protected status. Additionally Peru has regional, local, and private protected areas. Despite its size and diversity, the forest sector provided only 1 percent to Peru's GDP in 2010<sup>60</sup>. Mahogany is the most prized wood product, and non-wood forest products of greatest demand are cochineal (an insect from which the dye carmine is derived), brazil nuts, hearts of palm, and cat's claw (a vine used for medicinal purposes).

In recent years, foreign investments in Peru's oil deposits, which are located in Peru's forests, have become controversial because of the ecosystem damage and lack of social safeguards associated with exploration and extraction. Furthermore, coca production, while on the decline, has caused considerable deforestation over the past fifteen years.

## **2.4 NON-CLIMATE STRESSES**

Non-climate stresses are important barriers or constraints to the attainment of development goals and the success of development programs and projects. They also are important factors that can exacerbate the impact of climate change and reduce the effectiveness of actions to address climate impacts and vulnerability.

**Urbanization and Poor Planning and Management.** Well over half of Peruvians live in cities, but the policies, instruments and strong institutions for effective regional and city management and governability are lacking. Moreover, there are no regional sustainable development plans, city-wide development or risk management plans (although 1,156 of 1,834 municipalities have developed risk management plans through the Municipal Incentive Program administered through the MEF<sup>61</sup>), and institutional capacity for planning is low. Financial resources and technology to plan for and respond to environmental constraints and climate change is limited, and government and public knowledge and awareness about the impacts of climate change is low. The large urban poor populations of Lima, Chimbote, Trujillo, Arequipa and others are especially vulnerable because of poor housing and other infrastructure. Poor land use and urban planning often disproportionately affect the urban poor, as they are more likely to live in crowded, substandard housing on plots of land vulnerable to natural hazards.

To better manage risk of climate and non-climate related disasters, the National Civil Defense Institute (INDCECI) manages a Sustainable Cities Program that promotes growth based on disaster risk management and hazard mapping. This program is discussed in greater detail in Section 6. However, Peru's government institutions still lack the capacity to conduct planning studies and design sound urban development plans.

**Natural Hazards.** The geography of Peru and its varied topography further complicate efforts to reduce vulnerability through sound planning and resource allocation. Landslides and earthquakes (flooding is addressed in Section 4) are threats to lives and infrastructure, and challenge the capacity of national and subnational government agencies to respond. The location and quality of infrastructure is a major factor in understanding the level of risk that these hazards pose to a community. In Peru, housing and physical infrastructure is of low quality and not designed to withstand the stress of major natural hazard events.

**Governance.** Peru has many government institutions and ministries that are responsible for working on climate and climate-related issues, including the Ministry of Environment, Ministry of Economy and Finance, and Ministry of Energy and Mines. However, there is a lack of clear lines of responsibility for management and ownership of these issues. The government and decision making is very centralized, and yet management resources and capacity are low. Municipal funding is low (about 3.8 percent of the national budget went to the municipalities in 2000) and insufficient to conduct the type of development and risk management programs that the central government is asking for<sup>62</sup>. Representatives at the local level feel that the central government is operating in their municipalities, but not listening to the investment priorities of elected officials and citizens<sup>63</sup>. Incentive programs and environmental laws are passed with little additional training or financial support to fulfill municipal obligations.

**Poverty.** The National Statistics and Information Institute estimates that in 2010, 31.3 percent of Peru's population lived in poverty,<sup>64</sup> and 9.8 percent of the population was under conditions of extreme poverty<sup>65</sup>. Poverty increases vulnerability to disasters in many ways<sup>66</sup>: construction of housing where land is cheap, frequently on flood plains, river banks, steep hillsides, or reclaimed land; poor quality construction; lack of basic mitigation measures such as retention walls and adequate surface drainage; and marginal livelihoods and limited capacity for economic resilience. This vulnerability has been demonstrated many times in the past, such as in the two Lima earthquakes of 1966 and 1974, and the flooding in Ica in 1963 and 1998.

**Pollution.** Pollution from extractive industries and agricultural run-off are threatening already precious freshwater resources in Peru. Mining uses a great deal of water for processing minerals. This water is often diverted from rivers and streams, and used at the production site. Contaminated water is then either returned to its source or is discharged near the mine. Intensive agriculture is also contributing to the contamination of water and erosion and degradation of soil. Heavy use of fertilizer and pesticides (many of them banned in other countries) can contaminate surface and ground water, limiting the availability of safe drinking water. Inefficient irrigation diverts water from natural systems, and soils can become salinized over time. In addition to increasing agricultural inputs, farmers may cultivate land more intensively and expand into areas poorly suited for agriculture. Particularly when expanding cultivation up the hillside, soil erosion can be accelerated, silting rivers and streams and reducing the productivity of the land.

### 3. CLIMATE CHANGE IMPACTS AND VULNERABILITY

Climate variability and change are expected to affect the achievement of development objectives as a result of their collective impact on valued assets, inputs, people, and their livelihoods (hereafter,

referred to collectively as valued assets) and exacerbating development challenges where non-climate stresses are already a factor. This section provides an overview of the climate impacts of concern in Peru and critical climate vulnerabilities for selected valued assets.

### 3.1 IMPACTS OF CONCERN

All climate impacts of concern are the result of increased global GHG emissions. They can be organized into a hierarchy of primary, secondary, and tertiary effects (see Exhibit 3 below) to reflect the fact that higher level impacts contribute to lower level impacts.

**Exhibit 3. Hierarchy of Climate Impacts**

Process	Climate Impact
Increased GHGs → Greenhouse Effect	<b>Primary</b> Impacts: Temperature ↑ Water Vapor ↑
Increased atmospheric temperature	<b>Secondary</b> Impacts: Sea surface temperature ↑ Accelerated melting of ice caps and glacial retreat
Increased atmospheric and sea surface temperatures plus increased water vapor → changes in precipitation patterns and extreme events Increased sea surface temperatures and accelerated melting of ice caps and glacial retreat → Sea level rise	<b>Tertiary</b> Impacts: Changes in precipitation patterns Changes in extreme events Sea level rise

**Temperature.** The Andes mountain range splits the country in two and controls the climate of the country. Temperatures in Peru tend to be highest along the coast and southern jungle, lower in the jungles of the east, and lowest in the Andes highlands. On the eastern side of the country, the Atlantic air mass is caught against the mountains, creating tropical temperatures and high precipitation rates that make for a warm, humid climate. To the west of the range, the Humboldt Current brings cold waters north, creating a more temperate climate with desert conditions in the central and southern coastal area.

Climate ensemble models all show significant increases in average temperatures in Peru over the coming decades. As reported in Peru’s Second National Communication (SNC) submitted to the United Nations Framework Convention on Climate Change (UNFCCC), the National Meteorology and Hydrology Service (SENAMHI) reports that since 1960, on average, mean high temperatures are increasing at the rate of 0.2°C per decade<sup>67</sup>. There are also fewer nights with freezing temperatures, a trend that is more pronounced in the mountains where freezing nighttime temperatures are most common.

The Second National Communication predicts that by 2030, overall high temperatures may increase by up to 1.6°C; minimum temperatures may increase by up to 1.4°C. The greatest increases are likely to be seen along the north coast, in the north and central highlands, and in the jungle region to the east. The south-central coast and south jungle are expected to see little to no change in average temperatures<sup>68</sup>.



Also for the Second Communication, SENAMHI analyzed Global Circulation Models to produce climate change scenarios for Peru. The conclusion was that temperatures are likely to increase by up to 2°C by the end of 2050<sup>69</sup>. The range reported in the IPCC Fourth Assessment Report for Amazonia is an increase of 1 to 4°C by 2050<sup>70</sup>.

While temperature trends are important, temperature extremes within the trends can also have dramatic impact. Extreme cold spells damage crops and livestock; unusually hot periods can also impact crops and livestock as well as water supply and human health. The extreme swings in temperature are difficult to predict, and can even occur within a general warming or cooling trend. It is the unexpected nature of these events that makes them so damaging.

**Glacial Melt.** The most significant impact that climate change has already had on Peru is glacial retreat caused by increased temperatures. Over the last thirty years, Peru has lost 22 percent of its total glacier area<sup>71</sup>. SENAMHI's data predicts that glaciers will lose up to 37 percent of their current area by 2030<sup>72</sup>.

Accelerated glacial melt can result in several different types of impacts. Initially, glaciers may contribute higher volumes of water to the hydrological cycle, especially during the dry season. Scientists at Ohio State have perfected a method of analyzing glacial melt content of streamflow using O-18 isotopes that facilitates analysis of trends. In the Rio Santa, isotope analysis indicates that the contribution of glacial melt has already surpassed its maximum level and is now declining<sup>73</sup>.

The second and more dramatic impact of glacial melt is the formation and/or increase in the area and volume of glacial lakes and the resulting potential for glacial lake outburst floods (GLOFs). Since 1941, 30,000 people have been killed in the Cordillera Blanca in 30 glacier-related floods<sup>74</sup>. The largest of these disasters was a massive mudflow caused when a portion of Mount Huascaran broke away as a result of a devastating earthquake in 1970 and buried the town of Yungay, killing more than 20,000 people. The GOP has established the Glaciological and Hydrological Resources Unit within the National Water Authority (ANA) to manage 35 glacial lakes that have been determined to pose risks of GLOFs. However, in practice, this unit is limited to monitoring GLOFs; constitutional limitations make it impossible for the unit to implement any safety measures in the lakes<sup>75</sup>.

**Precipitation.** Annual precipitation levels have increased steadily along the coast and northern highlands since 1960; decreased in the jungles to the north; and shown little change in the rest of the country<sup>76</sup>. Although overall precipitation has not changed significantly, the intensity of rains and drought periods has increased, and dry periods are more intense than periods of rain. The intensity and frequency of rainfall is increasing the most along the coast and northern highlands, where annual precipitation averages increased between 30 and 40 percent between 1965 and 2006<sup>77</sup>.

Of the six Global Circulation Models reviewed for the Second Communication, each showed different distributions. SENAMHI has drawn rough conclusions that by the year 2030, there will be a predicted 10-20 percent decrease in average precipitation (as recorded between 1965 and 2006) along the southern coast. In the northern coast and highlands region, and parts of the central highlands and southern jungle, precipitation could increase as much as 20 percent<sup>78</sup> above the average recorded levels between 1965 and 2006.

**Extreme Events.** The Inter-American Development Bank identifies Peru as one of the most vulnerable countries in the Western Hemisphere to natural hazards; between 1970 and 2010, 72 percent of the natural disasters in Peru were climate-related<sup>79</sup>. The annual cost of climate- and non-climate-related natural disasters during the period 2000-2004 was around USD 325 million. The occurrence of disasters shows an increasing trend over the years: flooding increased by more than 60 percent from the period 1970-1980 to 1990-2000, and *huaycos* (mudflows) by almost 400 percent for the same period<sup>80</sup>. The severity of flooding is impacted by climate-related extreme weather events and non-climate stressors such as deforestation or poorly planned development. The frequency of extreme precipitation events is related to climate-related change; the intensity of damages is affected by non-climate stressors.

Between 2003 and 2007, extreme temperatures and floods have had the highest human and economic impact in Peru, with losses for the period 1997-2006 averaging 0.11 percent of GDP. At least 5 million people (around 18 percent of the country's population) have been affected by three extreme temperature events and 0.5 million people (around 2 percent of the country's population) were affected by one flooding event<sup>81</sup>.

Although some areas of Peru will see increased precipitation, across the country extreme rain events are expected to decrease in the next 30 years<sup>82</sup>. The most severe drought incidences occur at a higher frequency in the jungle and southern highlands than in the rest of the country<sup>83</sup>. Severe storms will significantly raise the risk of soil erosion and mass wasting especially in the steep mountains of the Andean region, which will put people, crops, and physical infrastructure at serious risk<sup>84</sup>. The El Niño Southern Oscillation (ENSO) phenomenon is a major force on Peru's climate, accounting for the periodic extreme weather events. However, it is difficult to predict if ENSO phenomena will occur more frequently or will intensify with climate change.

**Sea Level Rise.** Along the northern coast of Peru, sea level is expected to rise between 0.60 and 0.81 meters over the next 100 years<sup>85</sup>. This increase threatens the infrastructure that supports the majority of Peru's population, the health of fisheries and coastal ecosystems, and threatens the freshwater supply with saltwater encroachment.

Arguably the greatest consequence of sea level rise in Peru will be its impact on sea ports. The Port of Callao is the largest in Peru, handling 75 percent of the country's imports and exports, primarily metals, minerals, fish meal and fish oil<sup>86</sup>. There is no other port in Peru that can handle the volume and size of ships that come through Callao. Port infrastructure (docks, storage, railroad, roads) would need to be raised above the level of predicted sea level rise, a costly and time consuming undertaking.

### 3.2 CLIMATE VULNERABILITY

Vulnerability to climate change is a function of exposure to climate change and weather hazards, sensitivity to them, and adaptive capacity of society and the economy.

$$\text{Vulnerability} = f(\text{exposure, sensitivity, adaptive capacity})$$

**Exposure** refers to whether and to what extent the hazards have an impact on communities, ecosystems, and other assets. Measures of exposure can include the number of people or categories

of assets in hazard zones. **Sensitivity** indicates whether and to what degree the characteristics of a community or asset make it susceptible to the harmful effects of climate change hazards.

**Adaptive capacity** is the ability of communities and ecosystems to anticipate and/or respond to climatic changes in order to reduce vulnerability by, for instance, planting drought- and flood-resistant varieties of rice. Elements of adaptive capacity include more general considerations that are important for development such as human development, poverty levels, and social capital and networks, as well as climate-specific issues such as the existence and effectiveness of early warning systems for disasters and extreme events (e.g., floods, droughts, disease outbreaks, and crop/forest pests and diseases). Adaptive capacity can reduce the potential impact of climate change hazards in two ways, either by improving communities' and ecosystems' preparedness and ability to respond to climate change independent of exposure to climate change risks, or by reducing exposure. While improving technical capacity is an example of the former, implementing and enforcing zoning rules that restrict development in flood- and disaster-prone areas illustrates the latter.

### 3.3 VALUED SECTORS: WHAT IS AT RISK

Peru's highly diverse natural climate makes it difficult to assess climate-related vulnerability and risk trends at a national level. Some populations and environments will be more greatly affected by different climate-related impacts depending upon their location, socio-economic conditions and culture. Hence, coastal populations will be more sensitive to sea level rise and severe flooding of river basins, particularly during the ENSO cycle, and more affected by water scarcity as less glacial runoff reduces river flows. Highland populations will be more sensitive to extreme weather events and this sensitivity is heightened by the widespread poverty and poor infrastructure in the central cordillera region.

#### Water Resources

*Freshwater.* The widely accepted figure is that Peru's glaciers have retreated 22 percent in the last twenty-five to thirty-five years, which accounts for an estimated reduction of 12 percent of freshwater for the coastal zone<sup>87</sup>. The IPCC Fourth Assessment Report estimates with high confidence that Andean glaciers will disappear within decades. Scientists monitoring the glaciers high in the Andes Mountains - a key source of freshwater in Peru - say the ice is showing signs of shrinking faster than previously forecast.

Anticipated and already observed climate change related impacts caused by glacier retreat include deterioration of river basins, depletion of water recharge capacities, and biotic changes in ecosystem thresholds and composition, which affect the ecosystem's ability to store water. Since glaciers have typically provided continuous melt water to sustain river flows through droughts and the dry season, glacier fed rivers and streams will have lower dry season flows and increased variability with a diminishing mass of glaciers upstream<sup>88</sup>. However, the magnitude of changes in the hydrological cycle will vary depending on glacier location and stage of retreat<sup>89</sup>.

A greater percentage of glaciers being lost at a more rapid rate has great consequences for disaster risk management as well as for long term water storage/resources. This will not only impact ecosystems, but also irrigation, hydroelectricity production, and manufacturing. At high altitudes, glacial melt provides water for early planting, which is important for the short growing season, and

hydropower plants – particularly those in the Santa Rosa river basin – rely on glacial melt during the dry season to help keep river flows up. Like the more extreme ENSO events, larger glacier melt will bring too much water when water is plenty, and too little when water needs are greater. This will make water storage and efficient irrigation and water use systems important.

At the same time that water storage takes on increasing importance, it becomes more difficult. High levels of glacial melt can damage water storage and make distribution systems vulnerable, as increased runoff can create flash floods that carry a large amount of rock and glacial debris. In addition to the loss of water, melting glaciers create and/or expand mountain lakes. The destabilization of these lake walls can have devastating effects for people and land below them.

*Coastal Zone.* Sea level rise due to melting icebergs and warmer sea surface temperatures is likely to affect coastal cities and low lying land that may be under cultivation. The impact from sea level rise can be significantly compounded by the increase in extreme storm events, increasing the likelihood of danger to coastal populations and infrastructure. Ports, coastal roads, and structures all may be impacted or rendered inoperable by sea level rise and inundations.

### **Economic Activities and Livelihoods**

*Agriculture.* Agriculture in Peru contributes 62.8 percent of the national supply of food. Given that 66 percent of all farming lands are rain-fed, much of the agricultural sector and population in Peru will be affected by projected changes in rainfall patterns due to climate change. Within the agricultural population, women are especially active and so are likely to be an especially vulnerable group.

The most common effects from the ENSO in the Andean region are a good proxy for the kinds of long-term impacts that climate change will have on Peruvian agriculture generally, i.e. increasing droughts and changing levels of precipitation. Both kinds of impacts can cause reductions in crop yields and also lead to higher incidence of disease. A study performed in the Cañete Valley situated 140 km south of Lima, in the coastal region, showed that an increase in temperature between 1996 (a non-El Niño year) and 1997 (an El Niño year) led to a 45 percent increase in the occurrence of plagues for that period<sup>90</sup>. This led to a decrease in crop yields of 57 percent for the period 1996-1998. The yield losses for the most important crops were as follows: 56 percent for potatoes, 50 percent for cotton, and 46 percent for corn. The total damage due to the El Niño effect was concentrated in the agricultural sector and was valued at USD 613 million<sup>91</sup>.

Climate change is likely to be an intensifier of cyclical events like the ENSO leading to more widespread agricultural impacts and increasing the size and distribution of vulnerable populations. Analyzing the impacts of ENSO events provides a glimpse of the type and degree of impacts that can be expected from climate change. Warmer temperatures in the highlands may improve agricultural productivity; sustained high temperatures in the coastal region will threaten crop yields and increase the demand for irrigation.

Agriculture accounts for over 86 percent of the water usage in the country, yet 65 percent of this water is lost due to reliance on inefficient irrigation systems in coastal agricultural regions. Approximately 18 percent of Peru's irrigated areas have a serious level of land degradation (soil salinization and poor irrigation efficiency), 7 percent have a moderate level of degradation, and 15 percent have a relatively low level. The total area of degradation amounts to 307,000 hectares<sup>92</sup>.

The main causes for these occurrences are low irrigation efficiency, the widespread use of unimproved gravity and flood irrigation methods, cultivation of water intensive crops, lack of groundwater exploitation, and lack of maintenance of existing drainage systems.

Farming households will be especially sensitive population groups. Frost, hail, heavy snowfall, heat waves, cold snaps, and drought are all causing considerable damage and destroying crops that serve as a vital food source for already undernourished populations. In February 2007, for example, a particularly intense frost spell damaged crops so severely that the government had to set up an emergency response program to ensure that the rural populations affected would not starve to death.

*Fisheries.* The sea surface water off the coast of Peru is warming, which suppresses upwelling of nutrient-rich cold water, threatening the health of Peru's 736 known marine species and artisanal fisheries<sup>93</sup>. When these events occur, stocks of anchovies, a mainstay of the fishing industry, tend to diminish drastically. However, it can be difficult to distinguish between fishery decline due to climate change and decline due to overfishing and fishery mismanagement. While climate change will be a stressor on the industry, it may also create an opportunity to encourage better management as a principal adaptation measure.

*Mining and industry.* Mining and smelting operations have significant impacts on the livelihoods of local residents, including water and air pollution, erosion, and land degradation. Government concessions for oil and gas exploration, mining, biofuel production, and logging in areas where national parks, towns, farms and villages are located have caused local uprisings. There is a current conflict over the development of what could be the largest gold and copper mine in Peru, *Minas Conga*. The mine is expected to be worth USD 4.8 billion and produce between 580,000 and 680,000 ounces of gold per year<sup>94</sup>. However, the mine is very near to a major water basin, and local residents are protesting the mine over concerns of water pollution<sup>95</sup>.

Mineral mines use a lot of water for extraction and processing, and so the greatest risk of climate change to this important economic sector is access to water, and the regulations placed on the industry to control pollution. Many mining activities are not regulated or managed well and contribute to downstream pollution by heavy metals, which further exacerbate the challenge of meeting water quality requirements. Even if the challenge of achieving improved water quality by requiring mining industries to recycle and clean water during processing were achieved for the future, water quality and supply has already been compromised by the legacy of unmanaged mining wastes which leach into rivers and tributaries.

While mining uses a much smaller percentage of water than agriculture, the perception of their negative impact on water resources is a consequence of the scale of operations (one large mine, even using the best water management technology, can affect water availability and quality for hundreds of farmers and communities downstream) and the legacy of pollution that remains long after a mine has closed.

Both mining and other manufacturing and industrial processes are at risk not only of resource depletion, but also reduced access to markets if infrastructure fails. They also suffer from poor public image if their activities are seen to pollute or divert resources in neighboring communities. The mining sector experiences this most acutely, as many communities have demonstrated (sometimes violently) against mining operations in their region.

## Landscapes

*Mountains.* The Andes Mountain range not only controls the climate of Peru, this large mountain ecosystem is also extremely sensitive to climate change. In general, it is predicted that climate change will be more pronounced in high-elevation mountain ranges<sup>96</sup>. This leaves Peru highly vulnerable to climate change, as the runoff from the montane glaciers and annual snow pack supplies most of the water that is consumed on the dry western coast. The study of mountain hydrology in Peru is developing, particularly around the melting of glaciers and its implications for river flow for irrigation, human consumption, and hydropower generation. Observed climate change-related impacts include deteriorated river basins, reduced water recharge, and ecosystem changes that affect the ecosystem's ability to store water<sup>97</sup>. A recent study by the World Bank projects that there will be significant reduction in river discharges on the southern coast and northeastern part of Peru by the end of the century. However, the study was unable to make a single generalization about runoff for the country as a whole, as some areas will experience more runoff, and others will experience less<sup>98</sup>.

*Forests.* Peru's biodiversity is highly vulnerable to loss from climate change. The flora and fauna of Amazonia includes over 3,000 orchid species, 32 species of primates, and 312 species of endemic birds, and may be impacted by fluctuating precipitation levels. Widely fluctuating annual levels of rainfall would be highly stressful for forests and increase the risk of forest dieback due to tree infestations from weakened defenses. In addition, there is a trend towards expanding the agricultural frontier higher up into the cloud forest areas of the Andean foothills. As average temperatures rise, higher altitudes become appropriate for crops previously unsuitable. This provides farmers with incentives to clear upper montane forests, some of which contain massive stands of cedar and other valuable trees in a pristine climax forest state.

Increased migration is also threatening the Amazon rainforest, as rural poor from the Andes come in search of gold and participate in illegal mining activities. And this doesn't account for the planned mining activities – Peru could lose 56–91 percent of its forest by 2021 to make way for USD 80 billion of planned energy, hydrocarbon, mining projects<sup>99</sup>. In the past ten years alone, over a million hectares of tropical forest have been destroyed. The main reasons for rising deforestation rates are heavy population migration into the Amazon region and the associated encroachment of agricultural land, as well as road building and illegal logging. Over 50 percent of Peruvian GHG emissions originate from the burning and deforestation of forests and other land use changes.

**Infrastructure.** Impacts from climate change on infrastructure assets will come from a number of stressors. The flooding and mudslides that often accompany more extreme precipitation events will weaken the already inadequate transportation infrastructure, particularly that connecting the coastal region to the rest of the country. This will have a negative impact on all of the key economic sectors in Peru – manufacturing, agriculture, mining, fisheries, energy and tourism. Sea level rise and coastal erosion can limit access to and the depth of ports.

Coastal urban populations are especially sensitive because of sea level rise and extreme storms and the large urban poor populations of Lima, Chimbote, Trujillo, Arequipa, and others are especially vulnerable because of poor housing and other infrastructure. In Lima, the population expands each year by 120,000, increasing the demand for water, sanitation, transportation, and electric infrastructure services. But government and public knowledge and awareness about the impacts of

climate change in Peru's cities, their water supply and water quality is low, and there aren't enough financial resources and technology to adapt to environmental constraints due to climate change accordingly. Policies, instruments and strong institutions for regional and city management and governability are lacking and there are no regional sustainable development plans, city-wide development plans, or risk management plans.

Low institutional capacity in Peru to identify and analyze climate related risk and a lack of basic meteorological data and trends series means that risks to infrastructure cannot be adequately assessed, planned for, or managed. SENAMHI has a growing database of climate and weather data, but there isn't sufficient capacity to analyze that data to best inform decision and direct planning, particularly as each region is being asked to develop climate change strategies.

*Hydropower.* The electric infrastructure is also at risk; large hydropower capacity is threatened by reduced river flows from shrinking glaciers and fluctuations from ENSO events. From 2006 to 2009, over 50 percent of electric power in Peru was produced by hydropower, which is dependent on mountain water basins<sup>100</sup>.

Glacial retreat will most impact hydropower plants located on rivers where glaciers have a dominant role in the hydrological cycle (i.e., more than 5 percent of the watershed area is fed by the glacier)<sup>101</sup>. The main area affected by the melting of glaciers would be the Santa River basin, which feeds from the Cordillera Blanca, the largest mountain range in the country and a touristic region known for its scenic beauty and outdoor recreation activities. There is evidence that some tributaries of this river basin are already showing the impact of the glacier melting process, reducing its runoff during the dry season by as much as 20 to 25 percent<sup>102</sup>.

Arguably of greater importance to hydropower is the effect of climate change on rainfall patterns, because "hydropower generation is directly related to the volume and seasonal distribution of rainfall<sup>103</sup>." The IPCC models on rainfall patterns are not conclusive, and hydrology assessments do not show consistent trends – some regions are expected to experience reduced flow during the dry season and others will experience increased flows<sup>104</sup>.

**Human Health and Well-being.** Changes in temperature and precipitation can be linked to cardiovascular and respiratory illness as well as increases in the occurrence of infectious diseases<sup>105</sup>. To the extent that climate change reduces agriculture yields, it can also indirectly contribute to poor health from malnutrition. Studies of infectious disease and climate have focused on the impact of ENSO; the greater frequency of severe storms and floods increases the likelihood of the spread of cholera and other diseases caused by poor sanitation. One study showed an increase of 47.5 percent of acute diarrhea cases in Lima, Peru during the 1997-98 El Niño event<sup>106</sup>.

One of the main impacts arises from the spread of vector-borne diseases to regions where they have been historically absent, due to significant rises in average temperatures. The incidence of vector-borne diseases like malaria and dengue or diarrheal diseases can also increase as a result of compromised sanitation infrastructure<sup>107</sup>. Peru can also expect to see an increase in Chagas disease (a parasite that is related to the African parasite that causes sleeping sickness), and increased incidence of *leishmaniasis* (a protozoan skin infection), the vector for which has been shown to reproduce at greater rates and geographic spread with rising temperatures.

## 4. ADAPTATION PLANNING, PRIORITIES AND PROGRAMS

As vulnerability is a function of exposure, sensitivity, and adaptive capacity, reducing vulnerability will require reducing exposure and/or sensitivity and/or increasing adaptive capacity through adaptation. *Climate adaptation* refers to the ability of a system to adjust to climate change (including climate variability and extremes) to mitigate potential damage, take advantage of opportunities, or cope with the consequences. The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as:

...adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation<sup>108</sup>.

### 4.1 ADAPTATION PLANNING IN PERU

In terms of planned adaptation, Peru has organized vulnerability assessments and adaptation planning in virtually all major sectors of the economy as reflected in its Second National Communication. Peru has a national adaptation plan – *Plan de Acción de Adaptación y Mitigación frente al Cambio Climático* – and Law 27867 that requires each regional government to develop a Regional Strategy on Climate Change within the framework of the national strategy<sup>109</sup>. Regional assessments have been completed in four priority watersheds (Río Mantaro, Río Mayo, Río Piura, and Río Santa)<sup>110</sup>.

Peru's government is highly centralized, which facilitates this kind of national planning. But highly centralized systems also can mean weak local adaptation capacity as municipal governments await direction and budgetary resources from above. In the case of Peru, this has meant a focus on infrastructure and engineering measures, which although important, results in relative inattention to crucial public participation in adaptation awareness, education, planning, and economic resilience. In an effort to give more responsibility and resources to municipalities, the MEF has instituted the *Programa de Modernización Municipal*. Under this program, the national government determines objectives based on national policy, and provides funds to municipalities that take steps to achieve those objectives<sup>111</sup>.

The Sustainable Cities Program managed by INDECI aims to help municipalities to better understand their vulnerabilities, so that growth and development will be better able to withstand climate and non-climate disasters such as flooding, earthquakes, and tsunamis. The first stage (1998 – 2007) of the program collected data and created hazard maps and land use plans. The weakness in the program is implementation by municipalities, very few of which have the capacity to take the information provided by INDECI and implement a plan of action.

Despite the many government and non-governmental organizations working on climate-related issues (Ministry of the Environment, National Environment Fund, National Weather and Water Service, National Commission on Climate Change to name just a few), Peru's capacity to generate information to identify risk and take mitigating action is low<sup>112</sup>. Bilateral and multilateral donors are



also at work in Peru, investing in infrastructure improvements as well as studies, adaptation pilot projects, and awareness and education activities. One crucial gap is in reconciling differences between national priorities and local needs. Of the training that does exist, witnesses from The Mountain Institute recount that information provided is abstract and does not connect climate change to the concerns and priorities of Peru<sup>115</sup>. Resources should be directed toward making these trainings applicable and practical.

In Latin America, autonomous adaptation strategies include a variety of agricultural practices, ecosystem protection, and methods to adapt to extreme events. Some farmers in Peru continue to use an ancient irrigation and drainage system known as *waru waru*, or raised field agriculture, which makes it possible to bring into production the low-lying, flood prone, poorly drained lands that are found in the *Altiplano* and becoming more widespread due to climate change. However, these are labor-intensive systems and have been difficult to sustain without outside subsidies. In highland communities, there is interest in restoring the old canal irrigation system to make the most of water resources and reduce the risk of drought. And some Peruvian farmers continue to grow or are bringing back traditional crop varieties that may be better adapted to varying temperatures and precipitation levels, and more resistant to pests. Potatoes, olluco, and quinoa are crops that are native to the Andes and are resistant to drought, frost, and many pests. By continuing or renewing the utilization of traditional farming practices (crop diversity, irrigation, family plots, etc.), farmers in the Andes in general are already better adapted to predicted climate change than their coastal or large-scale agriculture counterparts.

## 4.2 ADAPTATION PRIORITIES OF THE PERUVIAN GOVERNMENT

Peru is party to the UNFCCC, and submitted its Initial National Communication in 2001; its Second National Communication followed in 2010 with the support of the Global Environmental Facility (GEF) and United Nations Development Programme (UNDP). The Second National Communication outlines climate scenarios to the year 2030 and evaluates the vulnerability of the following sectors: water, Amazon and biodiversity, agriculture, fishing and aquaculture, energy, and transportation<sup>114</sup>.

In Peru's first National Communication to the UNFCCC, proposed adaptation actions included prevention of infrastructure failure, construction of dams and tunnels to contain glacier lakes, and technology, information and capacity building to address the predicted increase in vector-borne diseases<sup>115</sup>. The Second National Communication focuses more on capacity building, information, and improving the enabling environment. The *Plan de Acción de Adaptación y Mitigación frente al Cambio Climático*, published in December 2010, identifies five pillars of their adaptation strategy:

- Information, research and system observation: giving priority to generating baseline statistics on climate, hydrology and meteorology; conducting a census of the environmental health of ecosystems; understanding the impact of climate change on individual sectors and ecosystems; and providing access to this information to outside groups.
- Build institutional capacity to generate and analyze climate data to inform decision making at local, regional and national levels.

- Create policy instruments and legal frameworks that take into account the impacts of climate change. This should cover instruments and goals including: national frameworks; sectoral development and strategic plans; and regional development plans and budgets.
- Technology application for infrastructure and knowledge management, including the application of ancestral knowledge.
- Innovative financing instruments for adaptation, and adjusting existing funding mechanisms to allow combining funds from different sources<sup>116</sup>.

The 2010 Plan complements two earlier national strategies created in 2003: the National Climate Change Strategy and the National Strategy Study for the Clean Development Mechanism. The former is to promote development policies that will increase adaptation capacity and reduce vulnerability to climate change; the latter identifies investment potential and financing options for greenhouse gas abatement projects<sup>117</sup>.

As noted earlier in this report, with the vast majority of Peru's population living in a desert, water is one of the resources most vulnerable to climate change because of the limited availability of water where it is demanded for manufacturing, consumption, hydropower and agriculture. Eighty percent of the nation's water resources are used in agriculture and much of this use has been inefficient and poorly managed, especially in the irrigation system.

With this in mind, Peru has established an integrated river basin management system through various legal reforms, including the creation of the Autoridad Nacional del Agua (ANA), which is the national authority responsible for ensuring the sustainable use of water resources through integrated natural resource management and strategic partnerships with national, regional, and local stakeholders<sup>118</sup>. This will allow water resources management to be more tailored to basin needs and capacity and build in stakeholder participation more systematically, which will be essential to addressing climate change impacts. The challenge for ANA and its counterparts will be to move away from the lowland-centric water policies that have favored large cities and agri-business over highland communities and local management.

Peru's Ministry of Environment (MINAM) was created in 2008 to manage the national environment sector in line with goals of economic growth and social equality. The Ministry of Environment has five dependent agencies that collect and analyze data, help to manage risk, and enforce existing laws and regulations related to natural resource use and protection<sup>119</sup>.

Environmental management and climate change are often linked together in Peruvian governmental assessments and plans as can be seen in the Peruvian Climate Change and Air Quality Program (PROCLIM) and the environmental management and adaptation/compliance program (PAMAs). Hydropower will continue to be a significant adaptation priority for the Government of Peru, especially due to glacial retreat and the gradual reduction of glacial melt streams that supply the dam/reservoir system. Though set up for different reasons, the National Environment Fund (FONAM) is now focused largely on climate change.

The key institutions in Peru seem to have a firm grasp on the threats and consequences of climate change on the environment, economy, and civil society, and there appears to be an institutional structure that can be mobilized to mitigate risk and reduce vulnerability. However, there is a gap

between understanding and capacity, regulation, and enforcement. At the 2009 International Conference-Workshop, *Adapting to a World Without Glaciers: Realities, Challenges and Actions*, the weakness of institutions in Peru was identified as a core theme, resulting in poor coordination and cooperation among government agencies and lack of compliance with environmental laws and regulations<sup>120</sup>. Lack of coordination and data collection and analysis also inhibits Peru's ability to identify and manage exposure to risk. The Inter-American Development Bank ranks Peru as having "low" risk identification capacity despite having several institutions that collect climate data<sup>121</sup>. It is perhaps for these reasons that the pending National Adaptation Plan will focus on strengthening systems and building capacity.

### **4.3 SUMMARY OF ONGOING ADAPTATION PROGRAMS**

#### **Government of Peru – National Programs**

The National Institute for Civil Defense (INDECI) has recently shifted focus to planning on reducing vulnerability to disasters (including those from climate change). INDECI implements the Sustainable Cities Program, which attempts to keep population centers from being severely affected by intense natural or manmade phenomena. At the national level, 103 urban centers have participated in the Program. Of those 103, 54 urban centers have Land Use Plans and measures to mitigate disaster, and 42 municipalities have approved studies for municipal ordaining and begun their implementation.

The Department of Climate Change, Desertification and Water (DGCCDRH) is situated within MINAM under the Strategic Development Deputy Minister of Natural Resources. DGCCDRH is responsible for policy formulation and national standards for the management of climate change, in coordination with the UNFCCC. It is also responsible for the National Climate Change Strategy, which establishes adaptation and mitigation strategies for Peru. DGCCDRH manages the Climate Change Portal for MINAM, which provides the public with information about climate change, how it may affect their lives, and what the government is doing to mitigate and/or adapt to climate change<sup>122</sup>.

In addition to the *Programa de Modernización Municipal*, MEF is working with MINAM, the Ministry of Foreign Affairs and the private sector to create a coordinating agency for climate change activities. And in March 2012, MEF is planning to release a study on the impacts of climate change on the economy<sup>123</sup>.

Integrated Local Assessments are being carried out for 5 watersheds (Piura, Mantaro, Mayo, Santa, and Urubamba River Basins) with the objective of assessing vulnerability and identifying adaptation options in water resources, agriculture, and hydropower. The information from these assessments will be incorporated into local and regional development plans<sup>124</sup>.

#### **Donor Programs**

As of 2007, the GEF was funding nine climate change projects in Peru, totaling over USD 27 million. Under the new Resource Allocation Framework, Peru will greatly benefit from the GEF, and is eligible to receive roughly USD 30 million in grant funding for biodiversity, USD 5-10 million for climate change and adaptation, plus additional GEF funds for land degradation and international waters.

The Inter-American Development Bank has approved a USD 24 million loan to reduce vulnerability to natural disasters by supporting the Peruvian government in strengthening institutional capacity to identify and reduce risks from natural hazards.

The Swiss Agency for Development and Cooperation (SDC) has undertaken a major partnership with the Peruvian Government through the *Program on Climate Change Adaptation in Peru (PACC)*. Working in Cusco and Apurímac, PACC is improving the adaptive capacity of local populations through awareness campaigns and adaptation measures.

With funding from GEF, CARE and the Andean Community General Secretariat are implementing the *Adaptation to Impacts of Rapid Glacier Retreat in the Tropical Andes (PRAA)* Project. PRAA is working in Peru, Bolivia and Ecuador to strengthen the resilience of local ecosystems and economies in the face of rapid glacier retreat in the tropical Andes. Under the project, CARE is conducting two pilot projects in each country to identify and illustrate the costs and benefits of adaptation practices and to generate knowledge on best practices to be used to design large-scale projects in other vulnerable communities and relevant sectors. In Peru, the PRAA project is working in the Shullcas sub-basin of the Mantaro watershed, fed by the Huaytapallana glacier, and in several micro-basins in the Santa Teresa district which is fed by the Salkantay and Sacsara glaciers that flow into the Urubamba–Vilcanota River. The two pilot projects promote integrated participatory management of the respective watershed and micro-basins to reduce risks from landslides and mudslides, and improve crop diversification.

In the *Plan de Acción de Adaptación y Mitigación Frente al Cambio Climático*, there is a detailed listing of adaptation and mitigation projects that have been approved and funded, are in development, or still in concept phase. These projects are funded by both the Government of Peru and donors, and are being implemented in cooperation with the Government of Peru – primarily through MINAM. A summary of those projects that have been approved and funded can be found in Exhibit 4 below. This table has been created based on information in the *Plan de Acción* and only includes those projects that are related to adaptation.

**Exhibit 4. Adaptation Programs included in the *Plan de Acción de Adaptacion y Mitigación Frente al Cambio Climático***

Name		Objectives	Funder(s)	Funding Level (Soles)	Implementing Agency(s)	Theme	Geographic focus
1.	Proyecto de Manejo de Suelos en Apurímac (Land Management Project in Apurímac)	The Swiss mining company Xstrata is seeking permission for an open-pit copper mine in Bambas, Apurimac. This may provide an opportunity for sustainable and mutually-beneficial land management through engagement of government, community, and private sector stakeholders. The project seeks to develop a model of sustainable land management in the context constructive interaction between government, communities, private sector and civil society, in order to reduce degradation of soil and other natural resources.	UNDP, XSTRATA, Regional Government	41,000,000	MINAM	Adaptation Measures Against Climate Change	Las Bambas, Apurímac
2.	Adaptación al impacto del retroceso acelerado de glaciares en los Andes Tropicales - PRAA (Adaptation to the impact of accelerated glacier retreat in the Andes Tropical)	Enhancing resilience of ecosystems and local economies to the impacts of tropical glacier in the Andes through the implementation of pilot activities assessing the costs and benefits of adaptation to climate change.	GEF and JICA	9,375,000	MINAM	Adaptation Measures Against Climate Change	Junin: Shullcas River Subwatershed (Huancayo and El Tambo Districts) Cusco: Salkantay associated Catchments (District of Santa Teresa)
3.	Programa de Adaptación al Cambio Climático - PACC (Climate Change Adaptation Program)	Promote the implementation of strategies and adaptation measures to climate change in the regions of Apurimac and Cusco, involving people and public and private institutions.	Swiss Agency for Development and Cooperation	13,400,000	Regional Governments of Cusco and Apurímac, SENAMHI, IGP, CONCYTEC, CIP, INIA, INDECI, UNALM, PUCP, UNSAAC,	Adaptation Measures Against Climate Change	Cusco: Microbasin of Huacrahuacho, and Kunturkanqui Checca districts in the province of Canas.

Name		Objectives	Funder(s)	Funding Level (Soles)	Implementing Agency(s)	Theme	Geographic focus
					UNAMBA		Apurimac: Microbasin of Mollebamba, Juan Espinoza Medrano District, Province Antabamba.
4.	Gestión Integral Adaptativa de Recursos Ambientales para minimizar vulnerabilidades al Cambio Climático en Microcuencas Altoandinas – Programa Interagencial (Adaptive Integrated Management of Environmental Resources to Minimize Vulnerability to Climate Change in High Andean Micro-watersheds - Interagency Program)	Strengthen the capacities of regional and local governments and organizations to conduct integrated and adaptive management of climate change vulnerabilities in two high Andean watersheds in Apurimac and Cusco.	UNDP, FAO, Pan American Health Organization, UNEP	11,150,000	MINAM	Adaptation Measures Against Climate Change	Cusco and Apurimac
5.	Programa Regional “Adaptación al Cambio Climático en los Países Andinos” (Regional Programme "Adaptation to Climate Change in Andean Countries")	Implementing sustainable strategies for adaptation in agriculture in selected countries of the Andean region.	GTZ	EU 6,000,000	Community of Andean Nations	Adaptation Measures Against Climate Change	Bolivia, Ecuador, Colombia and Peru
6.	Seguros Agrarios ante el Fenómeno del Niño: dirigido a reducir la pobreza, crisis de recuperación, adaptación	Improve the ability of households to manage climate risks and deepen their knowledge by developing a culture of finance and insurance for recovery.	UNDP	20,000,000	UNDP	Adaptation Measures Against Climate Change	Piura

Name	Objectives	Funder(s)	Funding Level (Soles)	Implementing Agency(s)	Theme	Geographic focus
	al cambio climático, y la necesidad de crear capacidades (Agricultural Insurance against El Niño: targeted at poverty reduction, crisis recovery, climate change adaptation, and capacity building needs)					
7.	Proyecto de Desarrollo Estratégico de los Recursos Naturales (Strategic Development of Natural Resources)	Belgian Technical Cooperation	10,440,000	MINAM	Adaptation Measures Against Climate Change	Apurímac
8.	Programa Diálogo Político del Cambio Climático en apoyo a la Comisión Nacional de Cambio Climático (Program of Climate Change Policy Dialogue in support of the National Climate Change Commission)	Swiss Embassy Cooperation Office in Lima	600,000	Swiss Agency for Development and Cooperation	Integrating Adaptation and Mitigation in the Decision Making Process	National
9.	Evaluación local integrada de cuencas para fortalecer la gestión regional en cambio climático (Local integrated watershed assessment to strengthen regional management climate change)	Tacna Basin: MINAM Nanay Basin: to be determined	90,000 (Tacna) 90,000 (Nanay)	MINAM, Regional and Local Governments	Research and Systemic Observation of Climate Change	Tacna and Nanay basins in Loreto
10.	Evaluación de los impactos	IDB	912,000	MINAM, MEF	Research and	National

Name	Objectives	Funder(s)	Funding Level (Soles)	Implementing Agency(s)	Theme	Geographic focus
económicos del cambio climático en el Perú (Evaluation of the economic impacts of climate change in Peru)	impacts associated with climate change for the main productive sectors of Peru.			and Ministry of Foreign Relations	Systemic Observation of Climate Change	
11. Capacitación de Tomadores de Decisiones de Gobiernos Regionales y Locales (Capacity Building for Decision Makers in Regional and Local Governments)	Improve the level of understanding of basic information required for making decisions and taking actions against climate change.	MINAM, IDB, SADC	130,000 (MINAM) 601,794 (IDB)	MINAM	Capacity Building and Public Awareness	Piura, San Martín, La Libertad, Ancash, Junín, Huancavelica, Ayacucho, Pasco, Cusco and Apurímac
12. Fortalecimiento Institucional Ambiental (Strengthening of Environmental Institutions)	Support the organization and institutional strengthening of the Ministry of Environment, specifically the Deputy Minister of Environmental Management, Assessment, and Oversight	GTZ	7,700,000	MINAM	Capacity Building and Public Awareness	National



## USAID Programs

*Peaks to Coast* (Glaciers to the Coast) is a USD 1.2 million, three year project implemented by The Mountain Institute (TMI) with USAID funding. TMI is developing cooperation with communities and municipalities located in the upper sections of the two major river basins of northwestern Peru, the Santa and Chira rivers in Ancash and Piura Regions. Community groups design grassland and forest restoration and conservation plans in cooperation with municipalities as a means to buffer climate change impacts. In partnership with these municipalities, the project supports the development of climate change adaptation plans and fosters cooperation of highland communities and municipalities with lowland groups that depend on mountain water for the sustainability of their agricultural export economies.

In 2011, USAID made a new grant to the Asociación Especializada para el Desarrollo Sostenible (AEDES), an organization focused on sustainable development in rural communities in the southern Andes. This project aims to strengthen community awareness and resilience to the impacts of global climate changes that negatively affect livelihoods in rural areas. AEDES plans to work more than 5,000 families, 20 municipal governments, and 50 local organizations over the next three years. Activities will be focused on two high-risk watersheds, and will include analyzing vulnerabilities and capacities, promoting the use of best practices in natural resources management through trainings and competitions, and incorporating climate risk management in development plans and projects.

## NGO Programs

The International Institute for Sustainable Development is developing an extensive list of current adaptation activities in Peru. Annex A combines their information with the programs that we have found.

## 5. GAPS

This report provides initial thoughts on gaps and possible priority areas for adaptation funding. It is not an exhaustive list, given time constraints and the limitations of the desktop study methodology. Options should be further vetted through local, regional, and/or national stakeholder consultations, and considered in light of USAID/Peru's funding priorities and the US government's Global Climate Change Initiative guidelines.

Gaps in geographic focus include, most notably, the Sierra Norte region, including the Departments of Cajamarca, Huánuco, and Junín, as well as coastal areas of La Libertad, Ancash, Lima and Ica. These departments each have growing urban populations that add pressure to the increasing demand for water, land, and infrastructure. In Cajamarca, mining disputes have recently resurfaced as a major source of conflict in the region, as the national government tries to balance economic growth with competing demands for water and concern over water quality. There may be an opportunity to work with mining companies, national and local governments, and community groups to design an approach to mining development that is responsive to the needs of private and public stakeholders, and manages land and water resources in a sustainable way for all parties.

The table in Annex B lists adaptation projects by sector. While Water, Capacity Building, Agriculture, and Biodiversity are well represented, there may be an opportunity in the sector of

planning and risk management, particularly as it pertains to infrastructure. As Peru moves from a commodity-focused economy to a service economy, the strength of its roads, airports, ports, water and sanitation services, electricity network, and communications networks will be critical to attracting businesses and investors that will keep Peru's economy on a path of positive growth. Development of climate-resilient planning tools and building practices would benefit Peruvians by making their physical and economic environments more secure.

Projects that address the effect of climate change on health and human welfare also lack strong representation in Peru. It would be beneficial to understand the degree to which climate change may alter the incidence of vector- and water-borne diseases due to warming temperatures, reduced water availability, or changes in nutrition due to a shift in crops.

**Education and Training.** Lack of information among scientists, government officials, and the general public about climate change, anticipated impacts, and possible mitigation and/or adaptation actions is a serious concern. Without experienced advisors, Peruvian government officials will have a difficult time adopting policies and drafting laws that protect resources and ease citizens into a new climate paradigm. Education programs in hydrology, climatology and earth sciences need to receive greater support in order to create local expertise and a solid core of scientists that can apply climate science to the local context.

The local capacity to assess vulnerability and undertake large scale adaptation activities is hindered by the compartmentalization of Peru's governing structure. Watersheds and mineral deposits are not contained by political boundaries. Coordination between Departments on adaptation measures is important, but rarely occurs. There needs to be greater incentive from the national government and/or donors to bring Departments together to learn about the cross-boundary resource issues and how to develop long term plans that focus on an ecosystem or watershed rather than a political department.

Capacity building activities in climate change adaptation appear to be taking place throughout the country. What is not clear is the extent to which these activities have improved the adaptive capacity of Peru's government and citizens. Before funding additional capacity building work, it may be beneficial to all donors to have an assessment of adaptive capacity in Peru, the source of that knowledge, the effectiveness of existing training and education programs, and remaining gaps.

## **6. RECOMMENDATIONS ON PRIORITY SECTORS AND/OR GEOGRAPHIC REGIONS**

### ***Overarching recommendations***

- Peru's **overall climate adaptation strategy** is to mainstream adaptation into national and regional policies and development and governance programs. According to this strategy, the state is responsible for protecting citizens against the impacts of climate change and for establishing new laws regarding the environment. The national strategy includes the application of risk management strategies such as the improvement of climate observation systems, the drafting of a national research agenda for technological development and innovation, and the development of estimates and climate change scenarios. The end goal of these practices is to improve the country's management of resources and greenhouse gases

without compromising its sustainable development progress. Under the leadership of Peru's new President, Ollanta Humala, the adaptation strategy may change, as President Humala came to power with promises to expand economic opportunity for all Peruvians and find a way to balance economic growth with environmental health and social justice.

- Decision-makers in Peru need to be trained to assess vulnerability and design and implement climate resilient programs. They should be able to understand climate data and projections and the impacts and vulnerabilities of key sectors. They then should be able to integrate this information into development programs, policies and plans so that vulnerability to projected climate change is minimized. Stakeholders and civil society also need to become more aware of climate change impacts and how their lives and livelihoods may be affected. Education and public awareness campaigns targeted to stakeholders, citizens, and students at all levels will foster a better informed public. Climate science can be integrated into curricula in coordination with the Ministry of Education. Key climate change concepts and adaptation policies can be developed in the three major languages of Peru (Spanish, Quecha, Aymara) and made available in print form in relevant public agencies and/or on a Web portal such as the Climate Change Portal hosted by MINAM.
- Research capacity in Peru should also be strengthened. Government agencies should be trained to better collect and analyze historical climate data and climate trends and projections as well as how to conduct research on the response of ecosystems to both climate and non-climate stressors, and monitor water availability. Trainings should also focus on ways to make the information accessible and user-friendly. The priority agencies to receive this training would be SENAMHI, the Instituto Geofísico del Perú (IGP), the Instituto del Mar del Perú (IMARPE) and ANA. Regional governments also need increased access to this information, and increased capacity to apply it to their planning and decisionmaking.
- With a significant number of research and data collection and analysis projects underway as well as pilot projects testing technologies or approaches to adaptation, many focused on water, it is highly recommended that the GOP **monitor the results or ongoing progress** of these activities and **share them via an interactive web portal** with all relevant stakeholders, including government agencies, the donor community, NGOs, Peruvian academia and the public, including private sector firms. There are a number of existing portals that could be built upon to serve this purpose. Case studies and best management practices could also be uploaded to the site for access by all interested parties.
- To further the capacity to engage stakeholders and monitor results, a graduate level or vocational training program could be developed to provide training in data collection, analysis, and adaptation program design. Students would learn from practical case studies and further develop a network of practitioners to facilitate learning and exchange of best practices.
- Since the GOP is relatively centralized, an early recommendation is to **promote adaptation planning and implementation at the local and regional levels**. Adaptation is about building resilience into society, the economy, resource management and infrastructure. This, in turn, requires widespread public participation and engagement of all local stakeholders. National, regional, and municipal government staff would benefit from training in facilitation methods to better elicit community concerns and perspectives. Awareness raising and

engagement can also be promoted through workshops and the media, and subsequently strengthening institutional links between local governments, grassroots organizations, local development boards, and the media.

There is wide acknowledgement that although Peru has the political will and institutions necessary to address climate change risks, they do not have the capacity to fully enforce existing laws or implement existing strategies and programs. Although capacity building programs have been underway for years, progress has been slow. Working at the national level can take a long time; focusing on regional institutions with the support of local NGOs and community associations may help gain traction and create lessons learned and best practices for plans and programs with a national focus.

The **main sectoral recommendations** for adaptation are described below.

### ***Sector-specific recommendations***

**Water Resources.** As noted above, water availability and use as well as pollution are high priorities for the GOP in addressing climate change. Numerous specific recommendations can be made to improve water resources management and use in light of climate change. Overall, it is recommended that the GOP focus on water resource availability, including increasing supply, as well as water conservation, reuse, and use efficiency, which currently is very low. Particular emphasis should be placed on the agriculture sector and moving toward less water-intensive production and processing systems and reducing losses. (See, for example, the agriculture recommendations below.)

### **Economic Activities and Livelihoods**

*Agriculture.* Staple crops, especially the potato, are susceptible to large fluctuations in the hydrological regime (droughts and floods), the effects of which can be exacerbated by extreme temperature changes and the emergence of new pests due to warmer average temperatures. Fortunately, Peru is home to thousands of different types of potato, and other staple crops such as quinoa and olloco, that are well-suited to the extreme growing conditions of Peru. Many are especially resistant to heat, cold, drought, or pests. By planting traditional varieties, farmers can increase the odds of a good harvest, regardless of the weather. These traditional varieties should be more systematically studied to see if some desirable traits can be introduced into other crops, or if distributing heirloom varieties more widely would be a useful adaptation strategy given ongoing changes in the climate.

Encouraging the use of both new agriculture technologies that are water and resource efficient (e.g. drip irrigation), or genetically modified crops in some cases and an evaluation of traditional cultivars and cultivation systems, like *waru-waru* is important. A program to encourage efficient irrigation techniques and a shift away from water-intensive crops can help farmers produce more food with fewer inputs.

*Mining and Industry.* In these sectors, the focus should be on a “no regrets” strategy in response to reduced availability of water due to glacial retreat, temperature increase, and changes in precipitation patterns. Efforts to recycle processed water and improve the utilization of water and energy have the potential to yield win-win outcomes by addressing climate concerns and reducing energy costs and GHG emissions. Reducing GHG emissions and aerosol, liquid, and solid pollutants will, in most

cases, also be indicators of improved efficiency of operations and reduced costs. In addition, improved water utilization and effective solid waste disposal practices will improve downstream water quality, thereby reducing external costs of other water users to treat water to standards required for potable water use. The potential costs of adaptation options can be reduced by energy efficiency programs such as co-generation that capture process heat, convert wastes into energy, and use turbines to convert discharge wastewater flows into energy. While the direct impact on global warming may be minimal, the positive impact on the net availability of clean water and other resources would be marked.

Adaptation also will require the government to more closely regulate the location and activities of industry. Plans to open up new tracts of land for mining should be evaluated in the context of water basin planning and water availability to assess the potential external costs of these new developments. One potential compensatory system could involve new mining operations supporting community water treatment and storage reservoir systems. To ease the transition to a more socially responsible mining and manufacturing industry, support could be given to develop corporate responsibility programs and policies that contribute to adaptation activities in the regions where they work.

## Landscapes

*Mountains.* As glaciers melt more rapidly than expected and as water supply from them dwindles, USAID should provide assistance to local governments and communities to develop and implement *paramo* and *puna* ecosystem management plans. Estimates in a 2002 study by Jorge Recharte show that if conserved and managed properly, the Peruvian *paramo* and *puna* systems could supply drinking water to approximately thirteen million Peruvians living on the coast<sup>125</sup>.

*Forests.* Addressing the water and related agriculture issues on the western slopes of the Andes may ease some of the migration-related pressure in the Amazon Basin. Direct adaptation measures in Amazonia will require greater participation of settlers and indigenous populations in changes to land tenure and land use, emphasizing sustainability and intensification vs. extensification of agriculture, and development of sustainable non-timber forest products and services.

**Infrastructure.** Adaptation will require changes in urban policies, planning, capacity building, and alterations to the physical structure of Peru's cities to varying degrees. But climate change also offers opportunities to significantly reduce a city's carbon footprint over time through new standards and investments in greener structures and infrastructure, more efficient transport modalities, substitution of renewables for fossil fuels, and more efficient power generation. The World Bank notes: "Urbanization if properly managed can also address the climate change agenda through the design of denser, more compact cities that increase energy efficiency and reduce travel time and costs for urban residents and businesses<sup>126</sup>."

Building the climate resiliency of vulnerable urban populations will require a renewed focus on the provision of serviced land for new shelter, and options to settle growing urban populations in sustainable resilient communities. To date, no climate resilient shelter plans or pilot projects have been implemented in Lima or other large cities.

**Human Health and Wellbeing.** More than one third of Peru's population lives on less than USD 2/day<sup>127</sup>. The poor – particularly the rural poor – are more vulnerable to the negative impacts of a

changing climate such as reduced water resources, deteriorating infrastructure, less productive agriculture, and climate-related health threats. They are at additional risk due to their distance from public institutions and legal frameworks that provide basic services and protections such as land rights and early warning systems and health services.

But these populations are not entirely without power or resources. Indigenous and traditional farming and conservation techniques can offer the broader Peruvian community insight and tools for how to better manage water, soil, and biodiversity resources. Identified as a core area at the 2009 *Adapting to a World without Glaciers* Workshop, better integrating these populations into mainstream adaptation efforts can be mutually beneficial for national adaptation priorities and indigenous communities. For instance, small-scale water management and irrigation programs can go a long way to improving livelihoods and promoting local economic development while reducing vulnerability to climate change.

An outreach effort to understand the needs of rural and urban poor, their experiences with climate change, and how they have been adapting (or think that they need to adapt) can be an initial step to understanding what resources are needed, and what knowledge is available to be shared.

## ANNEX A. ADAPTATION PROGRAMS

### Adaptation Programs

Name	Objectives	Funder(s)	Implementing Agency(s)	Type of project	Duration	Priority Sector(s)	Geographic focus (if any)	
<b>National Action</b>								
1.	Baseline Study on Public Policy Action and Budget Allocation of the Peruvian State with regards to Climate Change Adaptation	Understand the government response to climate change through public policies and allocation of public resources, by establishing a base line on policy and budgets in ministries and some regional governments and making recommendations on future monitoring of future actions.	Oxfam	Grupo Propuesta Ciudadana	Research	? - 2009	Multi-sectoral	National; regional in Piura and Cusco
2.	Peaks to Coast	Developing cooperation with communities and municipalities located in the upper sections of the two major river basins of northwestern Peru, the Santa and Chira rivers in Ancash and Piura Regions. Community groups design grassland and forest restoration and conservation plans in cooperation with municipalities as a means to buffer climate change impacts. In partnership with these municipalities, the project supports the development of climate change adaptation plans and fosters cooperation of highland communities and municipalities with lowland groups that depend on mountain water for the sustainability of their agricultural export economies.	USAID USD 1.2 million	The Mountain Institute	Community development, cooperation and capacity building	2009-2012	Water	Ancash and Piura Region
3.	Programa de Fortalecimiento de Capacidades Nacionales para Manejar el Impacto del Cambio Climático y Contaminación del Aire (PROCLIM)	Strengthen the country's overall national capacity via public and private sector institutions, along with over 70 partnering institutions throughout Peru's cities and regions. This program aims to enhance existing national climate change adaptation and emissions reduction capacity.	MINAM with financing support from Holland	MINAM	Capacity building		Multi-sectoral	National

Name		Objectives	Funder(s)	Implementing Agency(s)	Type of project	Duration	Priority Sector(s)	Geographic focus (if any)
4.	Sustainable Cities Program	Promote and orientate the growth and densification of cities on physically safe areas, first attribute of a Sustainable City, to make them competitive in long term, preventing that the productive installed capacity on safer areas to be destroyed. Identify projects and prevention measures for disasters mitigation. Convene the participation and support of local and regional authorities, community, public and private institutions and all the people involved in the local development. Promote the strengthening of a prevention culture in case of and technological natural disasters among authorities, institutions and population of the country.		National Institute for Civil Defense (INDECI)	Research and planning			National
5.	Market Strengthening and Livelihood Diversification in the Southern Highlands Project (Sierra Sur)	Helps poor Quechua and Aymara families improve the quality of their products, preserve their traditional knowledge and improve their management of natural resources to diversify their sources of income.	IFAD Budget: \$16 million	Government of Peru	Capacity Building	2005-2011	Natural resource management and economic development	Sierra Sur
6.	Project for Strengthening Assets, Markets and Rural Development Policies in the Northern Highlands (Sierra Norte)	Protect and enhance the natural and cultural heritage of poor rural households, strengthen community organizations in rural areas and open new markets for entrepreneurial activities.	IFAD Budget: \$14.4 million	Government of Peru	Capacity Building	2007-2012	Economic development	Sierra Norte
7.	Integrated and Adaptive Management of Environmental Resources and Climatic Risks in High Andean micro-watersheds <sup>128</sup>	Develop and reinforce the abilities of local and regional governments, communal authorities and the general population to improve local adaptive management of environmental resources and the provision of services in High Andean rural areas through a participatory, informed and decentralized perspective that effectively incorporates environmental and	Spain, through the MDG Achievement Fund Budget: USD 3.9 million	UNDP	Capacity building; Research	2008 – 2011	Water	Andes



Name	Objectives	Funder(s)	Implementing Agency(s)	Type of project	Duration	Priority Sector(s)	Geographic focus (if any)
	climate change issues into public policy decisions at the local and regional government levels.						
8. Climate Change Adaptation Programme in Peru (PACC) <sup>129</sup>	The programme seeks to reduce climate vulnerability for the local populations of Cuzco and Apurimac. Focussing on water resources, disaster prevention and food security, the PACC combines local and scientific knowledge in a resolutely transdisciplinary fashion in order to identify the most suitable adjustment measures. A few examples include increasing the number of water reserves, introducing crop varieties that are capable of enduring extreme weather conditions, integrating specific disaster prevention measures in regional planning.	SDC Budget: 12 million	Intercooperación, Libelula, PREDES, Ministry for Environment (MINAM)	Policy research; Adaptation measures	2008 – 2012	Water; Agriculture; Disaster risk reduction	Regions of Cusco and Apurimac
9. Q'emikuspa: Adaptation to climate change measures to protect and improve livelihoods of Alpaca and High-Andean indigenous communities	The project seeks to promote traditional methods to avoid increasing mortality of alpacas in the face of increasing climate risks which lead to water shortages.	Oxfam	Asociación Proyección; Practical ACTION	Action	2009 – 2012	Livestock	Caylloma (Arequipa) y Espinar (Cusco)
10. Study of the Economic Impacts of Climate Change in Peru <sup>130</sup>	This technical cooperation aims to fund studies to assess the impacts of climate change on priority sectors of the Peruvian economy. The studies will inform the Government of Peru on strategies and policy instruments. The study also seeks to strengthen institutional capacity of government agencies, as well as of those actors who will be mostly affected by the impacts of climate change. Finally, the cooperation aims to increase public awareness on socio-economic impacts of climate change in Peru.	IADB, co-financers Budget: IADB: USD 400,000; co-financing: 100,000	IADB	Policy research; Capacity building; Awareness raising	2009 - ?	Planning	National
11. Support Program for the Climate Change Agenda <sup>131</sup>	The objective of the program is to assist Peru in its efforts to create the legal, institutional, and technical conditions for preventing, mitigating, and responding to climate change and its	IADB Budget: USD 25 million	Government of Peru	Capacity building; Research; Policy	2010 - 2030	Ecosystems, other	National

Name	Objectives	Funder(s)	Implementing Agency(s)	Type of project	Duration	Priority Sector(s)	Geographic focus (if any)
	impacts on the country's future development, taking advantage of the investment and financing opportunities associated with carbon markets and international funding for adaptation and vulnerability reduction measures.	(loan)					
12. Support to the Strengthening of Regional Capacity for Climate Change Management <sup>132</sup>	The following technical cooperation seeks to support regional governments to overcome difficulties in the conformation of the Regional Climate Change Strategies. Additionally it will support the Ministry of Environment in the supervision and follow-up of the strategies.	IADB, co-financing  Budget: IADB: USD 400,000; co-financing: USD 100,000	Ministry of Environment (MINAM)	Capacity building; Policy	2010 - ?		National
13. Implementation of Adaptation Measures in Four Watersheds <sup>133</sup>	This technical cooperation will support the "Dirección de Cambio Climático, Desertificación y Recursos Hídricos" of the Ministry of Environment -MINAM-, in the preparation and execution of pilot adaptation measures.	IADB, co-financing  Budget: IADB: USD 1.0 million; co-financing: USD 250,000	Ministry of Environment (MINAM)	Pilot measures	2010 - ?		National
14. Terraces Recuperation in the Andes <sup>134</sup>	This project intends support research to scale up and find the technical and financial feasibility to let AGRORURAL co-finance with local and regional governments the implementation of a far-reaching program of pre-Columbian Andean terrace reconstruction as a practical way to execute adaptation projects in the field, in the scope of Andean indigenous communities impacted by Global Warming.	IADB  Budget: USD 1,325 million	Programa De Desarrollo Productivo Agrario	Policy research	2010 - ?	Agriculture (coffee)	Peruvian Andes
15. Actions to Reduce Negative Impacts of Climate Change in the Ocoña watershed <sup>135</sup>	Generation and systematization of information on the watershed, local capacity building and awareness raising with a view to reduce vulnerability of communities in the face of climate change.		AEDES	Research	Ongoing	Water	Ocoña watershed

Peru Climate Change Vulnerability and Adaptation Desktop Study

Name		Objectives	Funder(s)	Implementing Agency(s)	Type of project	Duration	Priority Sector(s)	Geographic focus (if any)
16.	Disaster Risk Management in the context of Extreme Meteorological Events (droughts, frost and heavy rain) as an Adaptation to Climate Change Measure in the Mantaro Valley	Strengthen risk management capacity in the face of extreme meteorological events such as droughts, frost and heavy rain, with a view to reducing vulnerability and improving adaptive capacity of the urban and rural population in the Mantaro Valley. The projects involves studies, capacity evaluation, the elaboration of an integrated risk management and adaptation plan and capacity building	IDRC	IGP	Policy research; Capacity building	2009 - 2011	Various	Mantaro Valley
17.	Strengthening Climate Change Adaptive Capacity of Local governments and organizations in Southern Peru		USAID \$858,776  Total: 2 million	AEDES	Capacity Building, based on application of risk management and adaptive practice with local organizations, municipal governments and Peruvian NGOs.	2011-2014	Climate Change Risk Management (rural) Natural and productive resources	Arequipa; NGOs in South Peru
18.	Aquafondo	To improve the quality and availability of water in the three water basins that feed Lima, Peru. Contributors created a fund that will finance conservation projects in the watersheds, good governance, and water resource management.	Grupo GEA, Fondo de las Américas, The Nature Conservancy, The Catholic University of Peru, Peruvian Society of Environmental Law, Union of Peruvian Breweries Backus and	The Nature Conservancy	Resource management, governance, conservation		Water	Lima, Peru

Name		Objectives	Funder(s)	Implementing Agency(s)	Type of project	Duration	Priority Sector(s)	Geographic focus (if any)
			Johnston S.A.A.  1 million initial investment into the fund					
<b>Participation in Regional and Global Actions</b>								
19.	Adaptation Strategies for River Basins (ADAPTS) Program	A strategy for climate change adaptation in the water sector that links local communities with investigators and development practitioners. In Peru: Vulnerability analysis complemented by glacier and water monitoring. Join municipal governments and communities to implement: water catchment dams (4), drip/sprinkler irrigation, forest conservation/reforestation, improve wetlands, and re-organize water distribution and field preparation by irrigation commissions and boards	Dutch Ministry of Foreign Affairs  Peru: 200,000E	IVM-IES, BothEnd Acacia Water AEDES in Peru	Investigation, capacity building and water resource management	2008-2011	Bottom-up approach to Climate Change adaptation in water sector	Country cases: Peru, Ethiopia, Ghana, Vietnam
20.	Initiative for the Conservation for the Andean Amazon (ICAA II) Program	Builds capacity and commitment across the Andean Amazon Basin in Colombia, Ecuador, Peru, and Bolivia for effective stewardship of the basin's nationally and globally important biological diversity and environmental services. This program supports adaptation goals in so far as it addresses aspects of natural resource governance and improved livelihood sustainability.	USAID USD 30.2 million	International Resources Group	Capacity building and natural resource management	2011-2015	NRM	Amazon Basin
21.	Integrated and Sustainable Management of Transboundary Water Resources in the Amazon River Basin Considering Climate Variability and Change <sup>136</sup>	To strengthen, in a coordinated and coherent manner, the institutional framework for planning and executing activities for the protection and sustainable management of the water resources of the Amazon River Basin, endeavoring to realize a shared vision of sustainable development in the region based upon the protection and integrated management of transboundary water resources	GEF, co-financing Budget: Total = USD \$51.5 million GEF = USD \$7.7 million	UNEP, Amazon Cooperation Treaty Organization, OAS	Institutional strengthening ; Policy research	2009 – 2014	Water	Regional: Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, Venezuela
			In Peru: Further information required.					

Name	Objectives	Funder(s)	Implementing Agency(s)	Type of project	Duration	Priority Sector(s)	Geographic focus (if any)
	and adaptation to climatic changes.						
22.	Climate Change in a Living Landscape: Vulnerability and adaptation in the Eastern Cordillera Real of Colombia, Ecuador and Peru <sup>137</sup>	EU	WWF, national partners	Policy research	? – 2010	Agriculture, Conservation	<i>Regional:</i> Eastern Cordillera Real linking Colombia, Ecuador and Peru
		<i>In Peru:</i> Research focused on the Chinchipe river in the northeastern part of Peru belonging to the Eastern Cordillera Real.					
23.	Adaptation for Smallholders to Climate Change (AdapCC) <sup>138</sup>	GIZ	Cafédirect, Cepicafe	Research, Action	2007 – 2010	Agriculture (coffee, tea)	<i>Global:</i> Kenya, Mexico, Nicaragua, Peru, Tanzania, Uganda
		<i>In Peru:</i> The project looked at drought, frosts, erosion/landslides and strong winds, their impacts and adaptation strategies in Piura.					
24.	Design and Implementation of Pilot Climate Change Adaptation Measures in the Andean Region (PRAA Project) <sup>139</sup>	Special Climate Change Fund (SCCF), co-financing  Budget: USD 28.7 million	World Bank with Government ministries, regional organizations	Adaptation measures	2008 – 2012	Water (glaciers); Agriculture; Ecosystems	<i>Regional:</i> Bolivia, Ecuador, Peru, Venezuela
		<i>In Peru:</i> Implementation of measures in the Andes.					
25.	Capacity Development for Policy Makers: Addressing climate change in key sectors <sup>140</sup>	United Nations Foundation and the Governments of	UNDP is implementing the project in partnership with the UNFCCC	Capacity building; Knowledge exchange	2008 – 2010	Varies by country	<i>Global:</i> 20 countries <sup>141</sup> including Columbia, Ecuador,

Name	Objectives	Funder(s)	Implementing Agency(s)	Type of project	Duration	Priority Sector(s)	Geographic focus (if any)	
	for selected key sectors. As a result of this project, both the technical understanding of key climate change issues and their economic and policy implications within the context of the Convention will be enhanced.	Switzerland, Finland, Spain and Norway.  \$6,953,413 USD	Secretariat, International Strategy for Disaster Reduction and the United Nations Environment Programme				Paraguay, Peru and Uruguay	
<i>In Peru: The sectors of focus are agriculture, fisheries and water.<sup>142</sup></i>								
26.	Climate Policy 2012: Extension of the global project “Capacity Development for Policy Makers to Address Climate Change” <sup>143</sup>	The UNDP Regional Bureau for Latin America and the Caribbean has expanded on the global project, “Capacity Development for Policy Makers to Address Climate Change” in the LAC region to provide technical support to national policy makers and its Country Offices and strengthen capacity on budgetary issues related to the post-2012 climate regime. Activities include technical backstopping for countries that begin to consider adaptation to climate change in their National Development Plans.	Spain, UNDP  Budget: USD 3.6 million	UNDP	Capacity building	2009 – 2011	Finance	LAC Region: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, and Venezuela
<i>In Peru: see description for the project “Capacity Development for Policy Makers to Address Climate Change.”</i>								
27.	Climate Change Vulnerability Evaluation of Coastal and Marine Areas <sup>144</sup>	This project is part of the Ibero-American Programme on the Evaluation of Impacts, Vulnerability and Adaptation to Climate Change (PIACC) and aims to determine the impacts of	Spain	CEPAL, University of Cantabria, national	Capacity building; Research; Knowledge	2009 – 2011	Coastal-marine systems	Most RIOCC countries <sup>146</sup> including: Argentina,

Name	Objectives	Funder(s)	Implementing Agency(s)	Type of project	Duration	Priority Sector(s)	Geographic focus (if any)
	climate change on the coasts of any country in Spanish and Portuguese speaking countries of Latin America and the Caribbean. It has a particular focus on the dynamics of beaches, estuaries, lagoons, deltas, cliffs and dunes, coastal erosion, flood risks and coastal infrastructure. This initiative is linked to the project “Economics of Climate Change in Central America - Phase II” <sup>145</sup> funded by IADB, UK, Denmark, Spain, EU and Germany.		counterparts	platform			Brazil, Chile, Colombia, Ecuador, Peru, Uruguay and Venezuela
In Peru: Further information required.							
28.	Mitigation and Adaptation to Climate Change in Sustainable Forest Management in Ibero-America <sup>147</sup>	Spain	INIA, CIFOR, CATIE, Polytechnical University of Madrid (UPM)	Capacity building; Research; Knowledge platform	2009 – 2011	Forestry	RIOCC countries, <sup>148</sup> including: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, and Venezuela
In Peru: Further information required.							
29.	Territorial Approach to Climate Change <sup>149</sup>	UNDP	UNEP, UNDP, others	Capacity building	2009 - 2014	Varies by country	Global: Albania, Algeria, Colombia, Nigeria, Peru, Senegal, Uganda, Uruguay and others
In Peru: The project is being implemented in Piura, Northern Peru							
30.	Utilization of Potato Genetic Diversity as Tool to	IADB, co-financing	Fundación para la Promoción e	Research	2009 - ?	Agriculture	Regional: Bolivia, Peru

Name	Objectives	Funder(s)	Implementing Agency(s)	Type of project	Duration	Priority Sector(s)	Geographic focus (if any)
Adaptation to Climate Change <sup>150</sup>	climate change, in order to develop technological alternatives to counteract the direct and potential effects of climate change (drought and frost tolerant varieties; high quality seeds; tools for risk evaluation) and the negative impacts on farmers and their families; as well as develop a climate change prevention and mitigation plan suited to the particular conditions of communities in the high Andes.	Budget: USD 742,520	Investigación de Productores Andinos				
In Peru: Further information required.							
31. Climate Risk Management Technical Assistance Support Project	The project aims at increasing in-country capacities to manage current and future climate risks.	SIDA through UNDP; UNDP core finance	UNDP	Policy research	2010-2011	Varies by country	22 countries in Phase 2 (2010-2011)
In Peru: Following a literature review on the state-of-the-art of climate risk knowledge and management in Peru, two focused regional assessments in Piura and Junin will analyze vulnerabilities and risks, especially in agriculture, and identify priority risk reduction measures. Implementing agency: International Institute for Sustainable Development							
32. Adaptation to Climate Change of Wheat and Potatoes Productive Systems <sup>151</sup>	The objective of this program is to contribute to the improvement of the adaptive capacity of the region, through an increase in the competitiveness of the productive systems of potato and wheat to climate change in South America. Specifically, the project will support the selection and development of genotypes with increased tolerance to drought and high temperatures. The project is being led and implemented by local institutions.	IADB, co-financing  Budget: USD 920,000	Instituto de Investigaciones Agropecuarias	Research, action	2010 - ?	Agriculture	Regional: Chile, Peru, Uruguay
In Peru: Further information required.							
33. Climate Change Impacts on Biodiversity in the Tropical Andes: Climate risk, vulnerability and decision making tools for the planning of conservation <sup>152</sup>	“To provide tropical Andean countries with a standard methodology for estimating climate change risks for biodiversity at local scales that can be used to design adaptation measures tailored to particular conditions. Case studies will be conducted during three years (2011 - 2013) on short- to medium-term climate change trends, biodiversity patterns and gradients and the vulnerability of species and ecosystems to	John D. and Catherine T. MacArthur Foundation	IAI	Research	2011 – 2013	Nature	Regional: Bolivia, Colombia, Ecuador, Peru
In Peru: Further information required.							



Name	Objectives	Funder(s)	Implementing Agency(s)	Type of project	Duration	Priority Sector(s)	Geographic focus (if any)
	climate and land use changes in two cross-border areas: a) the Pacific slope of the Northern Andes, in the border region of Colombia and Ecuador; [and] (b) the Amazonian slope of the Central Andes, in the border region of Bolivia and Peru.”						
34.	Regional Climate Change Adaptation Project	GIZ Budget: EUR 7 million	CAN, Ministries	Capacity building	2011 – 2016	Agriculture	Regional: Bolivia, Colombia, Ecuador, Peru
In Peru: Further information required.							
35.	Peace Corps Renewable Energy and Climate Change Initiative	U.S. State Dept.	U.S. Peace Corps, U.S. State Dept.	Community-based adaptation, awareness	ongoing	Communities	Costa Rica, Dominican Republic, El Salvador, Guatemala, Guyana, Honduras, Nicaragua, Panama, Paraguay, Peru, Suriname
In Peru: Further information required.							
36.	Review of the Economics of Climate Change in South America <sup>153</sup>	IADB, UK, Denmark, Spain, EU, Germany	ECLAC	Policy Research	2008 – 2009	Planning	Regional: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela
In Peru: Further information required.							
37.	Integrating Climate Change	Spain	UNEP	Capacity	2010 – 2013	Planning;	LAC Region:

Name	Objectives	Funder(s)	Implementing Agency(s)	Type of project	Duration	Priority Sector(s)	Geographic focus (if any)
Adaptation into National Development Processes in Latin America and the Caribbean	ecological systems in the region by integrating adaptation options into national planning processes and building the associated capacity of key regional and national institutions. The project will: undertake impact and vulnerability assessments; identify good practices and gaps in integrating adaptation into policy and plans; and support adaptation planning and its integration into national development processes. It will focus on the most vulnerable sectors and ecosystems, especially water and agriculture.	Budget: USD 4,375,233		building; Policy integration		Agriculture; Water	Phase 1: 19 RIOCC countries <sup>154</sup>  Phase 2: 3-5 countries (Dominican Republic 1st country selected)
<i>In Peru: Further information required.</i>							
38. Climate Change and Biodiversity Information in the Tropical Andes (Información de Cambio Climático y Biodiversidad para el Fomento de Políticas Públicas de Conservación y Adaptación en la Región de los Andes Tropicales) <sup>155</sup>	The objective of the project is to create a regional system of public information on climate change and its potential impact on the biodiversity of the tropical Andes. The aim of the project is to contribute in the generation of public policies and the insertion of biodiversity conservation into the national climate change plans of participant countries.	IADB; co-financing  Budget: USD 878,720	Centro Internacional para la Investigación del Fenómeno de El Niño	Policy (formation); capacity building	2011 - ?	Biodiversity, conservation	Regional: Bolivia, Colombia, Ecuador, Peru
<i>In Peru: N/A</i>							

## ANNEX B. ADAPTATION PROGRAMS BY SECTOR

Project Name	Objectives	Funder(s)	Geographic focus (if any)
<b>Water</b>			
Peaks to Coast	In partnership with municipalities, the project supports the development of climate change adaptation plans and fosters cooperation of highland communities and municipalities with lowland groups that depend on mountain water for the sustainability of their agricultural export economies.	USAID	Ancash and Piura Region
Integrated and Adaptive Management of Environmental Resources and Climatic Risks in High Andean micro-watersheds	Develop and reinforce the abilities of local and regional governments, communal authorities and the general population to improve local adaptive management of environmental resources and the provision of services.	Spain, through the MDG Achievement Fund	Andes
Actions to Reduce Negative Impacts of Climate Change in the Ocoña watershed	Generation and systematization of information about the watershed; local capacity building and awareness raising with a view to reduce vulnerability of communities in the face of climate change.		Ocoña watershed
Aquafondo	To improve the quality and availability of water in the three water basins that feed Lima, Peru. Contributors created a fund that will finance conservation projects in the watersheds, good governance, and water resource management.	Grupo GEA, Fondo de las Américas, The Nature Conservancy, The Catholic University of Peru, Peruvian Society of Environmental Law, Union of Peruvian Breweries Backus and Johnston S.A.A.	Lima, Peru
Integrated and Sustainable Management of Transboundary Water Resources in the Amazon River Basin Considering Climate Variability and Change	To strengthen the institutional framework for planning and executing activities for the protection and sustainable management of the water resources of the Amazon River Basin.	GEF	Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, Venezuela
Design and Implementation of Pilot Climate Change Adaptation Measures in the Andean Region (PRAA Project)	Implement measures to meet the anticipated consequences of the catastrophic glacier retreat induced by climate change through design and implementation of strategic pilot adaptation measures to address key impacts of glacier retreat.	Special Climate Change Fund (SCCF)	Bolivia, Ecuador, Peru, Venezuela
Adaptación al impacto del retroceso acelerado de glaciares en los Andes Tropicales - PRAA (Adaptation to the	Enhancing resilience of ecosystems and local economies to the impacts of tropical glacier retreat in the Andes through the implementation of pilot activities assessing the costs and benefits	GEF and JICA	Junin: Shullcas River Subwatershed (Huancayo and El Tambo Districts)

impact of accelerated glacier retreat in the Andes Tropical)	of adaptation to climate change.		Cusco: Salkantay associated Catchments (District of Santa Teresa)
Gestión Integral Adaptativa de Recursos Ambientales para minimizar vulnerabilidades al Cambio Climático en Microcuencas Altoandinas – Programa Interagencial (Adaptive Integrated Management of Environmental Resources to Minimize Vulnerability to Climate Change in High Andean Micro-watersheds - Interagency Program)	Strengthen the capacities of regional and local governments and organizations to conduct integrated and adaptive management of climate change vulnerabilities in two high Andean watersheds in Apurimac and Cusco.	UNDP, FAO, Pan American Health Organization, UNEP	Cusco and Apurimac
Evaluación local integrada de cuencas para fortalecer la gestión regional en cambio climático (Local integrated watershed assessment to strengthen regional management climate change)	Provide climate change planning skills to regions through the generation of comprehensive local assessments in priority watersheds.	Tacna Basin: MINAM Nanay Basin: to be determined	Tacna and Nanay basins in Loreto
Adaptation Strategies for River Basins (ADAPTS) Program	A strategy for climate change adaptation in the water sector that links local communities with investigators and development practitioners. In Peru: Vulnerability analysis complemented by glacier and water monitoring. Join municipal governments and communities to implement: water catchment dams (4), drip/sprinkler irrigation, forest conservation/reforestation, improve wetlands, and re-organize water distribution and field preparation by irrigation commissions and boards	Dutch Ministry of Foreign Affairs	Peru, Ethiopia, Ghana, Vietnam
<b>Agriculture</b>			
Climate Change Adaptation Programme in Peru (PACC)	Reduce climate vulnerability for the local populations of Cuzco and Apurimac, focusing on water resources, disaster prevention and food security.	SDC	Regions of Cusco and Apurimac
Q'emikuspa: Adaptation to climate change measures to protect and improve livelihoods of Alpaca and High-Andean indigenous communities	Promote traditional methods to avoid increasing mortality of alpacas in the face of increasing climate risks which lead to water shortages.	Oxfam	Caylloma (Arequipa) y Espinar (Cusco)
Terraces Recuperation in the Andes	Support research to scale up and find the technical and financial feasibility to co-finance pre-Columbian Andean terrace reconstruction as a practical way to execute adaptation projects in the field.	IADB	Peruvian Andes

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Climate Change in a Living Landscape: Vulnerability and adaptation in the Eastern Cordillera Real of Colombia, Ecuador and Peru	Improve regional coordination, maintain the integrity of natural ecosystems and promote sustainable livelihoods to reduce major conservation threats, including climate change.	EU	Eastern Cordillera Real linking Colombia, Ecuador and Peru
Adaptation for Smallholders to Climate Change (AdapCC)	The public-private partnership supports coffee and tea farmers of Cafédirect's supply chain in developing strategies to cope with the risks and impacts of climate change.	GIZ	Kenya, Mexico, Nicaragua, Peru, Tanzania, Uganda
Utilization of Potato Genetic Diversity as Tool to Adaptation to Climate Change	To contribute to the adaptation of potato production systems to the expected impact of climate change, in order to develop technological alternatives to counteract the direct and potential effects of climate change and the negative impacts on farmers and their families.	IADB	Bolivia, Peru
Adaptation to Climate Change of Wheat and Potatoes Productive Systems	Contribute to the improvement of the adaptive capacity of the region through an increase in the competitiveness of the productive systems of potato and wheat to climate change in South America.	IADB	Chile, Peru, Uruguay
Regional Climate Change Adaptation Project	Strengthen national food security strategies in the context of climate change adaptation; strengthen institutions in the agriculture sector.	GIZ	Bolivia, Colombia, Ecuador, Peru
Programa Regional "Adaptación al Cambio Climático en los Países Andinos" (Regional Programme "Adaptation to Climate Change in Andean Countries")	Implementing sustainable strategies for adaptation in agriculture in selected countries of the Andean region.	GIZ	Bolivia, Ecuador, Colombia and Peru
<b>Landscapes and Biodiversity</b>			
Market Strengthening and Livelihood Diversification in the Southern Highlands Project (Sierra Sur)	Help poor Quechua and Aymara families improve the quality of their products, preserve their traditional knowledge and improve their management of natural resources to diversify their sources of income.	IFAD	Sierra Sur
Initiative for the Conservation for the Andean Amazon (ICAA II) Program	Build capacity and commitment across the Andean Amazon Basin in Colombia, Ecuador, Peru, and Bolivia for effective stewardship of the basin's nationally and globally important biological diversity and environmental services.	USAID	Amazon Basin
Climate Change Impacts on Biodiversity in the Tropical Andes: Climate risk, vulnerability and decision making tools for the planning of conservation	To provide tropical Andean countries with a standard methodology for estimating climate change risks for biodiversity at local scales that can be used to design adaptation measures tailored to particular conditions.	John D. and Catherine T. MacArthur Foundation	Bolivia, Colombia, Ecuador, Peru

Climate Change and Biodiversity Information in the Tropical Andes (Información de Cambio Climático y Biodiversidad para el Fomento de Políticas Públicas de Conservación y Adaptación en la Región de los Andes Tropicales)	Create a regional system of public information on climate change and its potential impact on the biodiversity of the tropical Andes.	IADB	Bolivia, Colombia, Ecuador, Peru
Climate Change Vulnerability Evaluation of Coastal and Marine Areas	Part of the Ibero-American Programme on the Evaluation of Impacts, Vulnerability and Adaptation to Climate Change (PIACC) and aims to determine the impacts of climate change on the coasts of any country in Spanish and Portuguese speaking countries of Latin America and the Caribbean.	Spain	Argentina, Brazil, Chile, Colombia, Ecuador, Peru, Uruguay and Venezuela
Mitigation and Adaptation to Climate Change in Sustainable Forest Management in Ibero-America	Part of PIACC, this project aims to generate new information and knowledge and strengthen the capacity of research institutions in the forestry sector on linking sustainable forest management with adaptation and mitigation to climate change.	Spain	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, and Venezuela
Proyecto de Manejo de Suelos en Apurímac (Land Management Project in Apurímac)	Develop a model of sustainable land management in the context constructive interaction between government, communities, private sector and civil society, in order to reduce degradation of soil and other natural resources.	UNDP, XSTRATA, Regional Government	Las Bambas, Apurímac
<b>Capacity Building</b>			
Support Program for the Climate Change Agenda	Assist Peru in its efforts to create the legal, institutional, and technical conditions for preventing, mitigating, and responding to climate change and its impacts on the country's future development.	IADB	National
Capacitación de Tomadores de Decisiones de Gobiernos Regionales y Locales (Capacity Building for Decision Makers in Regional and Local Governments)	Improve the level of understanding of basic information required for making decisions and taking actions against climate change.	MINAM, IDB, SADC	Piura, San Martín, La Libertad, Ancash, Junín, Huancavelica, Ayacucho, Pasco, Cusco and Apurímac
Fortalecimiento Institucional Ambiental (Strengthening of Environmental Institutions)	Support the organization and institutional strengthening of the Ministry of Environment, specifically the Deputy Minister of Environmental Management, Assessment, and Oversight	GTZ	National
Baseline Study on Public Policy Action and Budget Allocation of the Peruvian State with regards to Climate Change Adaptation	Understand the government response to climate change through public policies and allocation of public resources by establishing a baseline on policy and budgets and making recommendations on monitoring of future actions.	Oxfam	National; regional in Piura and Cusco

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Support to the Strengthening of Regional Capacity for Climate Change Management	Support regional governments to overcome difficulties in the conformation of the Regional Climate Change Strategies. Additionally it will support the Ministry of Environment in the supervision and follow-up of the strategies.	IADB	National
Disaster Risk Management in the context of Extreme Meteorological Events (droughts, frost and heavy rain) as an Adaptation to Climate Change Measure in the Mantaro Valley	Strengthen risk management capacity in the face of extreme meteorological events with a view to reducing vulnerability and improving adaptive capacity of the urban and rural population in the Mantaro Valley.	IDRC	Mantaro Valley
Strengthening Climate Change Adaptive Capacity of Local governments and organizations in Southern Peru	Strengthening Climate Change Adaptive Capacity of Local governments and organizations in Southern Peru	USAID	Arequipa
Capacity Development for Policy Makers: Addressing climate change in key sectors	Capacity development initiative that supports two goals: 1. To increase national capacity to co-ordinate Ministerial views for more effective participation in the UNFCCC process; and 2. To assess investment and financial flows to address climate change for selected key sectors.	United Nations Foundation and the Governments of Switzerland, Finland, Spain and Norway.	20 countries including Columbia, Ecuador, Paraguay, Peru and Uruguay
Climate Policy 2012: Extension of the global project “Capacity Development for Policy Makers to Address Climate Change”	Provide technical support to national policy makers and its Country Offices and strengthen capacity on budgetary issues related to the post-2012 climate regime.	Spain, UNDP	Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, and Venezuela
Territorial Approach to Climate Change	Improve the resilience to climate change and reduce the carbon footprint in sub-national territories in developing and transition countries.	UNDP UNEP, UNDP, others	Albania, Algeria, Colombia, Nigeria, Peru, Senegal, Uganda, Uruguay, others
Climate Risk Management Technical Assistance Support Project	The project aims at increasing in-country capacities to manage current and future climate risks.	SIDA through UNDP; UNDP core finance	22 countries in Phase 2 (2010-2011)
Study of the Economic Impacts of Climate Change in Peru	Fund studies to assess the impacts of climate change on priority sectors of the Peruvian economy. The studies will inform the Government of Peru on strategies and policy instruments and strengthen institutional capacity of government agencies. Increase public awareness on socio-economic impacts of climate change.	IADB	National
Implementation of Adaptation Measures in Four Watersheds	Support the “Dirección de Cambio Climático, Desertificación y Recursos Hídricos” of MINAM in the preparation and execution of pilot adaptation measures.	IADB	National

Project for Strengthening Assets, Markets and Rural Development Policies in the Northern Highlands (Sierra Norte)	Protect and enhance the natural and cultural heritage of poor rural households, strengthen community organizations in rural areas and open new markets for entrepreneurial activities.	IFAD	Sierra Norte
Peace Corps Renewable Energy and Climate Change Initiative	Increase municipal, school and communities' awareness and knowledge of climate change (including adaptation) and support community-led projects, including on adaptation.	U.S. State Dept	Costa Rica, Dominican Republic, El Salvador, Guatemala, Guyana, Honduras, Nicaragua, Panama, Paraguay, Peru, Suriname
<b>Planning and Risk Management</b>			
Programa de Adaptación al Cambio Climático - PACC (Climate Change Adaptation Program)	Promote the implementation of strategies and adaptation measures to climate change in the regions of Apurimac and Cusco, involving people and public and private institutions.	SDC	Cusco: Microbasin of Huacrahuacho, and Kunturkanqui Checca districts in the province of Canas. Apurimac: Microbasin of Mollebamba, Juan Espinoza Medrano District, Province Antabamba.
Seguros Agrarios ante el Fenómeno del Niño: dirigido a reducir la pobreza, crisis de recuperación, adaptación al cambio climático, y la necesidad de crear capacidades (Agricultural Insurance against El Niño: targeted at poverty reduction, crisis recovery, climate change adaptation, and capacity building needs)	Improve the ability of households to manage climate risks and deepen their knowledge by developing a culture of finance and insurance for recovery.	UNDP	Piura
Proyecto de Desarrollo Estratégico de los Recursos Naturales (Strategic Development of Natural Resources)	Strengthen capacity at the national and regional levels for strategic development of natural resources.	Belgian Technical Cooperation	Apurímac
Programa Diálogo Político del Cambio Climático en apoyo a la Comisión Nacional de Cambio Climático (Program of Climate Change Policy Dialogue in support of the National Climate Change Commission)	Contribute to the formulation and adoption of a national position and policy toward international agreements for strategies and plans for mitigation and adaptation to the effects of climate change	Swiss Embassy Cooperation Office in Lima	National
Evaluación de los impactos económicos del cambio climático en el Perú	Create a detailed analysis of the economic impacts associated with climate change for the main productive sectors of Peru.	IDB	National



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(Evaluation of the economic impacts of climate change in Peru)			
Sustainable Cities Program	Promote and orientate the growth and densification of cities on physically safe areas to make them competitive in long term, preventing that the productive installed capacity on safer areas to be destroyed.	National Institute for Civil Defense (INDECI)	National
Integrating Climate Change Adaptation into National Development Processes in Latin America and the Caribbean	Build climate resilience of vulnerable human and ecological systems in the region by integrating adaptation options into national planning processes and building the associated capacity of key regional and national institutions.	Spain, UNEP	Phase 1: 19 RIOCC countries Phase 2: 3-5 countries (Dominican Republic 1st country selected)
Review of the Economics of Climate Change in South America	Make a socio-economic analysis of the impacts of climate change in selected countries of South America, develop mitigation and adaptation policies and leverage financial resources.	IADB, UK, Denmark, Spain, EU, Germany, ECLAC	Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela

## **ANNEX C. DESKTOP STUDY TERMS OF REFERENCE**

### **Terms of Reference**

#### **Peru climate change vulnerability and adaptation desktop study**

##### **I. Background**

The broad goal of climate change adaptation is to create societies that are resilient to adverse climate change impacts and have the ability to rise to both the challenges and the opportunities presented by a changing climate. USAID activities that support adaptation should be built upon climate vulnerability and adaptation analyses; this desktop study constitutes the first component of an assessment being undertaken by USAID/Peru with support from EGAT's Global Climate Change team.

Climate change trends affecting Peru include melting glaciers, changing rainfall patterns, increasing temperatures, and rising sea levels. Peru is highly vulnerable to these changes, as a large portion of Peruvians live in water-sensitive areas, work in agriculture or fishing, or live below poverty levels. USAID's adaptation investments will assist Peru to identify and reduce its vulnerability to such climate change impacts, in order to continue to achieve its development objectives.

##### **II. Objectives**

The report will be used to inform the in-country assessment process for possible future USAID/Peru-funded activities addressing climate change adaptation challenges.

The report will also serve as a model for other USAID missions that are beginning similar processes, by demonstrating what kinds of sources to review, what level of detail is appropriate, and what kind of logic to use to set priorities and focus in on particular sectors or gaps.

##### **III. Scope**

This is the first stage of a priority-setting exercise to inform USAID/Peru adaptation programming. This desktop study will summarize the climate change trends and projections relevant for Peru; describe the key climate change vulnerabilities and adaptation challenges; identify national priorities and areas where those are not already being addressed by other donors; and present and justify recommendations for sectors, actors, and/or geographic regions that should be the focus for the remainder of the assessment process carried out by USAID (including stakeholder consultations in October and one or more workshops in January).

The desktop study should consider the following "sectors", at a minimum:

- agriculture and food security;
- health;

- tourism;
- marine/fisheries
- other coastal (e.g., natural resources management, infrastructure)
- energy (hydropower)
- urban (infrastructure, services, etc.)

The desktop study should also consider the resources and inputs that are critical for these sectors and for the country's development priorities, including but not limited to the following:

- water resources, including major watersheds, glacial and river systems, river deltas, and water delivery and sanitation systems;
- forests, other terrestrial ecosystems and biodiversity;

The desktop study will draw from existing literature, including national plans and reports on key climate vulnerability/sensitivity initiatives. Where useful, information may be synthesized into tables and charts, such as sector-by-sector tables summarizing vulnerability of valued assets to alternative climate impacts.

#### **IV. Contents**

The following is a suggested outline for the report. IRG is invited to suggest changes to help ensure that the final product is logical and useful.

### **ANNOTATED OUTLINE (DRAFT)**

Executive Summary (up to 1 page)

1. Introduction (1/2 - 1 page)
  - 1.1 Background
  - 1.2 Purpose of the Report
  - 1.3 Approach and Methods
2. Development context (1-2 pages)
  - 2.1 Economic - key sectors in terms of GDP, employment, priorities for economic growth
  - 2.2 Social – demographics, trends, priorities for human development
  - 2.3 Ecological – critical ecosystems, geography, priorities for sustainable ecological management and conservation
3. Climate Change Impacts and Vulnerability (3-6 pages)
  - 3.1 Impacts of Concern
    - 3.1.1 Non-climate stresses (brief summary) - population, pollution, migration, corruption, etc.; socioeconomic scenario for near and middle term (e.g, urbanization, land development, population).
    - 3.1.2 Weather and climate – observed trends, projected climate change: temperature, precipitation, storms, glacial melt, sea level rise, etc., both near (2020s) and middle term (2050s)

- 3.2 Valued Assets: What is at Risk
  - 3.2.1 Anticipated impacts of climate change from literature to give an idea about relative significance of concerns (i.e., risk) (e.g., drought impacts on food security and agriculture, health, flood impacts on infrastructure, glacial melt impacts on water supply for different uses, etc.). Discussion of timing, severity, and consequences, to the extent possible.
- 3.3 Exposure, Sensitivity, and Adaptive Capacity
4. Existing efforts and remaining gaps (3-5 pages)
  - 4.1 Adaptation priorities of the Peruvian government – sectors, geographic areas, and/or activities - as laid out in policies and reports like the Second National Communication
  - 4.2 Summary of ongoing adaptation programs / efforts by the government, other donors, NGOs, universities, regional platforms, multilateral development banks, and the private sector
  - 4.3 Matrix or other visual tool to demonstrate high-priority gaps?
5. Recommendations on priority sectors and/or geographic regions to focus on during the remainder of the assessment process (including stakeholder consultations), based on the findings above (1-3 pages)

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### **V. Activities**

All of this work effort will be performed through a U.S.-based desktop study; sources to be reviewed may be in Spanish or English.

The report outline, approach, and content will be developed with oversight by the COTR and in close collaboration with Nora Ferm, the designated activity manager on the EGAT/GCC team. Nora will provide strategic direction and guidance throughout the process, and will help ensure close coordination with USAID/Peru/EGE. USAID/Peru/EGE has contributed to this Terms of Reference and will provide IRG with country context and resources as appropriate.

### **VI. Key deliverables**

The contractor will submit deliverables according to the following schedule:

- A draft of sections **x – x** is requested by September 30.
- The final report is due no later than November 14.

The report will be delivered to the COTR and the activity manager in Microsoft Word and PDF formats. No hard copies are needed.

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