

Name: Integrated National Adaptation Project (INAP)

Overall Objectives: Improve Colombia's understanding and assessment of impacts, vulnerability, and adaptation to climate change, climate variation, and extremes by supporting efforts to define and implement specific pilot adaptation measures and policy options to address anticipated climate impacts

NWP Work Areas: Methods and tools; data and observations; climate modeling, scenarios and downscaling; climate risks and extreme events; socio-economic information; adaptation planning and practices; research; and economic diversification

Project Purpose: This project takes an ecosystem-based approach (EbA) to adaptation to address climate change impacts that includes community-based initiatives and integrates the use of biodiversity and ecosystem services. Local communities depend on such biodiversity and ecosystem services for their well being and resilience to climate impacts. The EbA assists communities to adapt to climate change and develop a comprehensive adaptation strategy to be implemented at national, regional and/or local levels.

CI and its partners - IDEAM, National Institute of Hydrology, Meteorology and Environmental Studies; INVEMAR, National Coastal and Marine Research Institute; CORALINA, the Regional Environmental Authority of San Andres, Old Providence and Santa Catalina and the INS, National institute of Health, have supported the Colombian Government in creating an INAP.

The INAP provides guidance in the development of pilot projects aiming to reduce human and environmental vulnerability to climate change, with specific regards to high mountain ecosystems and Páramos coastal marine ecosystems and human health.

By engaging both local communities and governments through the INAP development process, CI supports capacity building in organizing resource management and conservation strategies aiming to increase the resilience of ecosystems and the services they provide. These services support sustainable food, water, and health and income security for millions of people in and around Bogota, Colombia, as well as the vulnerable communities of the Páramos and coastal regions.

Background: The INAP project addresses key vulnerabilities to climate change and the need for better information on climate. It includes four main components: a) making climate variability and climate change information available for policy development, b) adoption of adaptation measures in high mountain ecosystems, c) coastal and marine areas, and d) human health. Pilot adaptation measures were identified with the participation of local communities and implemented in order to build social and ecological resilience to climate change impacts and increase adaptive capacity of the human population. Adaptation measures implemented include natural solutions such as improvement of management of protected areas, land cover restoration, watershed management, farming systems improvement, land use planning, as well as other relevant actions such as education, local community empowerment, and participatory research. The project also includes monitoring of essential ecological processes and

ecosystems affected by climate change such as water and carbon cycles in the Andes, oceanographic phenomena and corals in coastal and marine areas.

Climate Change Impacts

Colombia faces multiple climate change mediated threats on both human and ecosystem services. Of these, the Páramos, coastal and marine ecosystems, and human health are critically vulnerable to the effects of climate change. High Andean ecosystems, including Páramos, unique in the Northern Andes are expected to be seriously affected by increases in temperature. In some areas, the IDEAM has recorded a net increase of 0.2 - 0.3°C per decade during the last 50 years and a decrease in rainfall between 2 to 3 mm per decade. This trend is increasing, affecting not only the biodiversity but also ecosystem goods and services, especially water supply and water regulation. Many rivers from the Andes are used to generate hydroelectricity. The ability to continue to generate power using hydrological demand depends on the continuing provision of stable water flows in high mountains and the pattern of precipitation. This project addresses these critical vulnerabilities by addressing both climate mediated threats and its ecosystem and human health effects. Climate change impacts on these identified issues are described below.

- **High mountain ecosystems and Paramos (*Páramos*)**

The Páramos are tropical Andean ecosystems consisting of a combination of lakes, peat bogs, grasslands, forests and shrub lands located in the northern Andes, approximately 3,000 meters above sea level. They stretch from northern Peru to Ecuador, Colombia and Venezuela, and occur in patches throughout Costa Rica and Panama. Climate change impacts in this region are:

- Carbon storing capacity is affected by temperature increase and rainfall reduction.
- Hydrologic and temperature changes lead to biodiversity loss and affect ecosystem services such as: provision of freshwater, regulation of water quality, groundwater recharge, and water holding capacity. These services are invaluable to enhancing local communities' resilience to climate change.
- Hydrologic changes may negatively affect Colombia's hydro-power industry, ultimately weakening the country's economic and energy resilience in the face of climate impacts.

- **Coastal marine ecosystems**

Small islands and low-lying coastal areas are particularly vulnerable to the effects of global climate change because of their limited natural resources, fragile and closely linked ecosystems, weak economy, small area, geographical dispersion and relatively high population densities. Possible impacts are: mean sea level rise, increased mean air and sea-surface temperatures, coastal erosion, marine ecosystem loss, salinity intrusion, changed oceanic oscillation and rainfall patterns, and altered frequency of severe weather events like tropical hurricanes and related occurrences. These impacts entail risks in terms of loss of life and damage to property and infrastructure.

Colombia's Caribbean insular areas total 61.8 km² of emerged territory, of which 90% is inhabited with a total population of about 70,000. Local economies depend mainly on tourism, industrial commerce, artisanal fishing, and traditional agriculture. Under a scenario of carbon dioxide doubling for the period 2050 – 2080, mean sea level is estimated to rise between 2 - 5 mm per year. Sea level rise may disrupt fisheries and tourism through the loss of key

ecosystems, beaches, coastal erosion, degradation of coastal ecosystems, and damage of infrastructure and unique and traditional sites. Climate change impacts in this region are:

- Sea level is expected to rise 40 cm by 2060.
 - Saline intrusion into aquifers will become more prevalent, affecting water supply and quality.
 - Loss of 17% of terrestrial land, including coastal areas of San Andres Island due to erosion and sea level rise.
 - Impact on wetlands, coral reefs, and atolls.
 - Coral bleaching will become more widespread and is anticipated to impact as much as 65% of regional fisheries
- **Human health**

The two mosquito-borne diseases (malaria and dengue have the greatest global impact on human health and well being) have recently re-emerged and as significant public health concern in Colombia. Both diseases continue to rise despite a wide variety of interventions available in vector control and treatment. Global warming influences dengue and malaria morbidity in several ways. Dengue and malaria virus and parasites reproduce almost exclusively in humans, and are transmitted by mosquitoes. Neither dengue virus nor malaria parasites are able to mature when ambient temperature is below 10 - 20°C. Climate change influences dengue and malaria transmission dynamics by affecting mosquitoes' life span, biting habits, digestion rate, larval development; development rate of pathogens (2 degrees temperature increment from 24 to 26°C is expected to more than double the number of infectious mosquitoes biting humans) and geographical distribution of vectors into vector free territories. Thus, the change in dynamics of both the disease cycle and range will create new challenges to the already resource-starved health system. The main objective of this project was to design and implement an integrated malaria and dengue surveillance and control system that addresses the new dynamics of transmission and exposure caused by climate change.

INAP Components and Corresponding Activities

- **Component A: Communicating Weather and Climate Forecasts to Decision Makers**
INAP aims to support both the technical and scientific capacity of the Institute of Hydrology, Meteorology and Environmental Studies (IDEAM) to produce relevant long-term climate change information and short-term weather monitoring data, including timely and reliable forecasts tailored to decision makers.

Activities

- IDEAM is now able to provide weather information and forecasts in a timely and reliable manner. This supports decision making in different sectors of the economy: water supply, energy, agriculture, etc. Information is available at: www.cambioclimatico.gov.co.
- Climate change and variability models are available at the national level, including the influence of El Niño-Southern Oscillation (ENSO).
- Climate change scenarios have been downscaled in three areas: San Andrés Island, Las Hermosas Massif, and Sabana de Bogotá.
- Weather forecasts for forty-one main cities in the country are available, including rainfall and temperatures every six hours.

- Capacity building in the form of staff members and professionals trained in meteorology. The project plans to train ten Masters level students in meteorology.

These achievements are important for supporting community resilience to climate change because ecosystem services such as water access and distribution are essential for maintaining healthy agricultural- and livestock-based livelihoods. These services also support the growth of medicinal flora, provision of fuel wood and wild food stocks. Informed decision-making is now possible with the availability of weather and climate forecasts, thereby enabling the Government of Columbia to make science-based decisions regarding adaptation policies.

- **Component B: Design and Implement an Adaptation Program that Supports Ecosystem Services in Chingaza: This component was implemented by IDEAM.**

Activities

- In the Rio Blanco Watershed, 207 vegetation restoration processes have been implemented. These projects depend on traditional knowledge in selecting native plants to be re-cultivated in areas of sparse vegetation and high forest fragmentation. Local communities were also consulted in the creation of the germination and propagation protocol.
 - In two municipalities located on the Chingaza Massif, La Calera and Choachí, land use plans were updated to include adaptation measures such as land restoration, farm plans and adaptive use plans in eight “veredas.” The Adaptive Territorial Ecological Structure (EETA) framework guides these land use plans. According to INAP, an EETA is defined as “a geographical network of spaces that supports essential ecological processes in order to guide adaptation beyond biodiversity conservation towards the maintenance of structure and functioning of ecosystems. The main objective of EETA is to maintain ecological integrity and ecosystem health.”
 - The “farm plans” aim to build social resilience by improving living conditions and reducing vulnerability to climate impacts through ecosystem-based approaches to adaptation. Through the implementation of tree fences, organic fertilizers, home gardens, diversification of products, soil and water conservation practices, and recovering local knowledge regarding sustainable farming, farm plans enhance resilience of communities.
 - A management plan in Río Claro has been adopted that will help prevent activities such as fires that would further reduce water retention capacity in soil.
 - Eight communities have signed local-level agreements on ecosystem restoration and land use changes at farm level, through Adaptive Life Plans (ALP). ALPs are social agreements developed through ‘self-reflection discussions’ of local communities’ adaptive capacity.
- **Component C: Design and Implement an Adaptation Program that Supports Colombian Caribbean Insular Areas: Implemented by INVEMAR and CORALINA.**
The Seaflower Marine Protected Area (MPA) around the San Andres Islands is Colombia’s first MPA and the largest in the Caribbean, covering roughly 65,000 km². It protects the Caribbean’s most extensive open-ocean coral reefs. Yet, over-extraction underpinned by poverty, food

insecurity, and the local communities' lack of ownership over marine resources continue to be the main drivers of this ecosystem's degradation.

Activities

- Research was completed on the impacts of climate change on corals, including an assessment of coral sensibility to global climate change and coral connectivity. More information is available at:
<http://www.invemar.org.co/cambioclimatico/noticias.jsp?id=4193&idcat=145>
<http://www.invemar.org.co/cambioclimatico/noticias.jsp?id=4141&idcat=145>
 - INAP helped create a rainwater harvesting and wastewater recovery system in two San Andres Island settlements Tom Hooker and Ciudad Paraíso. These pilots benefit 165 people and are expected to receive a water quality monitoring system.
 - An enforcement strategy was developed to prevent marine ecosystem degradation in the MPA.
 - A Pilot Management Plan for Cay Bolivar is currently underway.
 - A demarcation plan for a coral conservation area in the Seaflower MPA was produced. INAP has also received Technical support of the Florida Keys National Marine Sanctuary. It includes installation of equipment of anchoring; buoys in conservation and special use areas.
- **Component D: Responses to the increased exposure to tropical vector-borne diseases induced by Climate Change. Implemented by The National Institute of Health.**

Vector-borne diseases such as malaria and dengue fever are predicted to penetrate areas historically unaffected because of warmer temperatures. The INAP project has supported the National Institute of Health in implementing an early warning system to forecast malaria and dengue outbreaks. These efforts assist the government and others to design programs that protect and prepare vulnerable communities for epidemics. These efforts are helping to reduce the incidence of infection by as much as thirty percent.

Activities

- An Integrated Dengue and Malaria Surveillance and Control System (IDMSCS), including an Early Warning System to improve malaria and dengue Surveillance and Control (DMEWS), has been implemented in eight municipalities to achieve the goal of reduction in incidence of infection by thirty percent.
- Accurate climate models to forecast dengue and malaria outbreaks (75% of predictability) were developed in strengthening health security in Colombia.
- Institutional capacity has been strengthened to diagnose and train local health staff in pilot areas in areas of quality control.
- Models were also used to predict transmission dynamics in municipalities affected during La Niña events in 2010 and 2011, in order to prevent the occurrence of both malaria and dengue.

Results

- Strengthened IDEAM capability to produce and disseminate relevant climate change information through availability of continuous accurate and reliable climate data for adaptation.

- Guidelines to incorporate climate variability and climate change in land use plans of the Chingaza Massif.
- Restoration actions implemented in high mountain ecosystems to reduce vulnerability of ecosystem services and increase resilience of local population.
- Farming systems improved to reduce vulnerability and increase the livelihoods of local communities in pilot areas of the Chingaza Massif.
- Adaptation pilots designed and implemented with corresponding monitoring systems in place for the Caribbean insular areas including increased management performance of key marine ecosystems and reduced vulnerability of local communities to changes in water supply.
- Strengthened public health program able to meet the increased threats from dengue and malaria induced by climate change.

Indicators of Success

- Level of enhanced forest and coral connectivity
- Avoidance of major vector disease outbreaks
- Effectiveness of land management schemes
- Reduction in alien invasive species
- Increase in population of native species
- Greater understanding of water cycles