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06

# Climate Vulnerability and Risks in the Agriculture Sector of Latin America





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# Climate Vulnerability and Risks

in the Agriculture Sector  
of Latin America

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## Projects and entities included in this document

“Resilient food production in horticulture-livestock systems for family farming in climatically vulnerable regions of Argentina and Colombia”.



Ministerio de Agricultura,  
Ganadería y Pesca  
**Argentina**

“Climate-resilient coffee landscapes in the tri-national zone of the dry corridor of Honduras”.



Hanns R. Neumann Stiftung



OFICINA PRESIDENCIAL DE  
CAMBIO CLIMÁTICO

“Biodiversity and good, climate-smart agricultural practices to improve resilience and productivity in family agriculture in potato-based agrifood systems”



BOLIVIA MINISTERIO DE  
DESARROLLO RURAL Y TIERRAS

## Entities



Organización de las Naciones  
Unidas para la Alimentación  
y la Agricultura



**SICA**  
Sistema de la Integración  
Centroamericana

# Contents

Abbreviations and acronyms.....	1
Foreword.....	2
Theoretical concept of vulnerability and risk assessment.....	3
From theory to practice .....	4
Argentina and Colombia: participatory vulnerability assessment with vulnerable communities.....	4
Honduras: analysing the vulnerability of coffee plantations.....	7
Ecuador: diagnosis using empirical and scientific data.....	10
Climate services: information for decision-making .....	12
Developing monitoring systems for extreme events and drought in response to climate service needs for food security.....	14
Monitoring drought in Central America using the ASIS platform.....	17
Conclusions .....	19
References.....	21



## Abbreviations and acronyms

AFOLU	Agriculture, Forestry and Other Land Use	INSIVUMEH	Instituto Nacional de Tecnología Agropecuaria (National Agricultural Technology Institute)
AR4	Fourth Assessment Report of the Intergovernmental Panel on Climate Change	INTA	Instituto Nacional de Tecnología Agropecuaria
AR5	Fifth Assessment Report of the Intergovernmental Panel on Climate Change	IPCC	<b>Intergovernmental Panel on Climate Change</b>
ASIS	Agriculture Stress Index System	M&E	Monitoring and evaluation
AVHRR	Advanced Very High-Resolution Radiometers	MAE	Ministerio de Ambiente de Ecuador (Ministry of the Environment of Ecuador)
BMZ	Federal Ministry for Economic Cooperation and Development (Germany)	MARN	Ministerio de Medio Ambiente y Recursos Naturales (Ministry of the Environment and Natural Resources)
CATIE	Tropical Agricultural Research and Higher Education Center	MIDA	Ministerio de Desarrollo Agropecuario (Ministry of Agriculture and Livestock Development)
CFA	Cool Farm Alliance	NDC	Nationally Determined Contributions to the Paris Agreement
CIP	Centro Internacional de la Papa (International Potato Centre)	NOAA	National Oceanic and Atmospheric Administration
CIPAV	Centro para la Investigación en Sistemas Sostenibles de Producción Agropecuaria (Centre for Research on Sustainable Agricultural Production Systems)	OECD	Organization for Economic Co-operation and Development
CRRH	Comité Regional de Recursos Hidráulicos (Regional Hydraulic Resources Committee)	PROGRESAN-SICA	Programa de Sistemas de Información para la Resiliencia en Seguridad Alimentaria y Nutricional de la Región del Sistema de Integración Centroamericano (Information Systems for Resilience and Food and Nutritional Security Programme of the Central American Integration System)
EF	Expertise France	RFP	Resilient Food Production
FAO	United Nations Food and Agriculture Organization	SAG	Secretaría de Agricultura y Ganadería (Agriculture and Livestock Secretariat)
FBE	Forests, Biodiversity and Ecosystems	SICA	Sistema de la Integración Centroamericana (Central American Integration System)
GFCS	Global Framework for Climate Services	SPI	Standardized Precipitation Index
GIZ	<i>Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH</i>	LST	Land Surface Temperature
IHCAFE	Instituto Hondureño del Café (Honduran Coffee Institute)	VHI	Vegetation Health Index
IICA	Inter-American Institute for Cooperation on Agriculture	WMO	World Meteorological Organization
INETER	Instituto Nicaragüense de Estudios Territoriales (Nicaraguan Territorial Studies Institute)		

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## Foreword

The technical document Climate Vulnerability and Risks in the Agriculture Sector of Latin America is part of the series of publications based on the webinars and round table discussions organized by the EUROCLIMA+ programme in the Resilient Food Production (RFP) sector from September 2019 through November 2021.

The webinars were arranged to facilitate multisectoral exchange between key actors of the EUROCLIMA+ programme and to strengthen their technical and methodological capacities based on the experience gained from the projects implemented, in cooperation with the implementing organizations, the co-implementing organizations and the project partners in the Agriculture, Forestry and Other Land Use (AFOLU) sector. The webinars provided opportunities to identify synergies between the RFP sector and other sectors, such as the Forests, Biodiversity and Ecosystems (FBE) and the Disaster Risk Reduction (DRR) sectors.

The exchange of experiences aimed to support scaling up good practices; promote climate governance and improved climate policies, strategies and financing mechanisms for climate change adaptation and mitigation; and reinforce monitoring systems that provide information for regular country reports on the fulfilment of the Nationally Determined Contributions (NDCs).

In 2021, EUROCLIMA+ organized four international round table discussions, thus creating additional opportunities to exchange experiences and strengthen climate governance in Latin America's agrifood sector.

Systematizing and disseminating experiences and lessons learned is vital in the EUROCLIMA+ programme. Thus, strengthening knowledge management capacities and sharing knowledge is one of the four critical elements of Expertise

France's technical assistance strategy for the agrifood sector of the EUROCLIMA+ programme. This publication results from those efforts and is intended to facilitate access to relevant, timely, and succinct information regarding technical experiences and solutions for resilient food production. Also arising from these efforts are EUROCLIMA+'s Green Solutions, which systematize results, good practices and lessons learned that can be replicated and scaled up in other contexts and can potentially promote green recovery in the countries and accelerate the implementation of their NDCs.

This publication is based on experiences shared during the webinars "Hydrological risks in the agriculture sector: methodological advances for climate services" and "Lessons learned in participatory climate vulnerability baseline assessment," both held in 2020. The publication defines the theoretical concepts of climate vulnerability and risk. It provides case studies and lessons learned in climate measurement and in establishing vulnerability baselines of different family farming systems, which were shared by key actors in projects co-financed by EUROCLIMA+ in Argentina, Colombia, Honduras and Ecuador by various regional institutions.

We hope you enjoy this publication.

**Clémentine Moriceau**

**Project Chief, Technical Assistance for the Resilient  
Food Production EUROCLIMA+ Programme  
Expertise France**

# Theoretical concept of vulnerability and risk assessment

The Intergovernmental Panel on Climate Change (IPCC) was created in 1988 to provide integrated assessments of the state of scientific, technical and socio-economic knowledge regarding climate change, its causes, possible repercussions and response strategies. By 2021, the IPCC has prepared six assessment reports and several special reports.

To facilitate the understanding and use of the concepts of vulnerability and adaptation, the first concept of vulnerability was presented in the Fourth Assessment Report (AR4), published in 2007. The Fifth Assessment Report (AR5), published in 2014, presents revised concepts of risk and vulnerability, aiming for greater congruence with the terminology used in disaster risk management.

The IPCC (2014) defines climate risk as to the outcome of three variables:

**Hazard:** The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources. The term hazard usually refers to climate-related physical events or trends or their physical impacts in this report.

**Vulnerability:** The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

**Exposure:** The presence of people, livelihoods, species or ecosystems, environmental functions, services and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected by extreme climate events.

As such, risk defines the potential consequences in situations where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as the probability of the occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. In AR5, this term is usually used to refer to the possibilities, when the outcome is uncertain, of adverse effects for life, including livelihoods; health; ecosystems; species; economic, social, or cultural assets; services (including environmental services) and infrastructure (IPCC, 2014).

To facilitate the mainstreaming of climate change adaptation, the Organisation for Economic Co-operation and Development (OECD, 2019) published the policy guidance book “Integrating Climate Change Adaptation into Development Co-operation: Policy Guidance,” which applies the concept of the IPCC’s AR4 report from 2007, after which many countries incorporated the AR4 concept into their planning processes. Since 2014, the countries have begun adopting the modified AR5 concept.

# From theory to practice

## Argentina and Colombia: participatory vulnerability assessment with vulnerable communities

From 2019 to 2021, the National Agricultural Technology Institute (INTA), in Argentina, and the Centre for Research on Sustainable Agricultural Production Systems (CIPAV), in Colombia, in collaboration with the Inter-American Institute for Cooperation on Agriculture (IICA) and the Agriculture Ministry of Argentina, implemented the EUROCLIMA+ project “Resilient food production in horticulture-livestock systems for family farming in climatically vulnerable regions of Argentina and Colombia.” The project was implemented in Colombia’s Amazonian piedmont forest and in three regions in Argentina – the Chaco Serrano woodland, the peri-urban horticultural belt around La Plata and the Patagonian valleys – supporting more than 200 families. The project applied a vulnerability analysis method promoted by GIZ (Fritzsche et al., 2016).

### 1. Preparation for the assessment:

A set of guiding questions was developed for each climate risk factor, adapted to each territory.

### 2. Seventeen workshops were held in which the following activities were carried out:

- **Participatory development of a climate timeline** and introduction to the concept of climate risk.
- **Group work to identify factors** in each of the components of climate risk.
- **The development of impact chains** describes the cause-effect relationship of the risk and connects the three risk factors of hazard, exposure, and vulnerability.
- **Reflection on possible** adaptation measures.



Source: Barth, I. et al. 2021

### 3. Post-workshop analysis:

- **Results printed and visits** made to each farmer to share and discuss the results and prioritize.
- **Workshop results** linked to scientific climate data.
- **Together with the families**, adaptation measures based on the participatory risk analysis are defined and developed in water management, soil management, and organizational strengthening.

Source: Pascuale Bovi, J. y Barth, I. 202VV

## Lessons learned

It is essential to conduct a pilot workshop to make the necessary adjustments to the participatory methodology.

It is necessary to adapt the approach to each territory and the reality of family farming, balancing scientific rigor and pragmatism in the interventions with the families.

The assessment process highlights risk factors beyond those related to climate exposure and hazards, such as economic and social vulnerability (housing, education levels, etc.), which describe the unit of interest when focusing on families or communities.

When planning the assessment, the agricultural production cycle should be considered to ensure that the families will be available to participate.

It is important to incorporate the gender approach into the process. This requires:

- Creating gender-segregated spaces for discussion to ensure women can speak freely;
- Finalizing the workshop using surveys, individual interviews or small group discussion;
- Having gender-specialized advisory assistance during project implementation.





## Lessons learned

Good working knowledge of the intervention area: IHCAFE works with agencies in seven coffee farming regions (regions are defined based on biophysical and socio-economic characteristics). The regions have been subdivided into sectors for the baseline assessment.

Determination of the sample size: the baseline study must represent the territorial stratification of the farms.

Participatory planning:

- IHCAFE leads the process, working with the farmer organizations to organize the workshops in the communities.
- The local governments and the farmers are engaged by proposing a win-win relationship.
- As the farmers will benefit from the assessment and the climate-adaptation action plans developed specifically for their farms, they are motivated to participate transparently and provide accurate data.

Digital data collection: A digital data management system that uses smart mobile devices and uploads the information directly to the virtual platform. This supports efficient data collection, standard criteria, and data consolidation.

Replicability of the methodology: This methodology is being replicated and adapted in Guatemala, Costa Rica and Nicaragua. A study will be conducted to evaluate the effectiveness of the adaptation measures, based on a previous CATIE experience in the Santa Bárbara municipality, which determined that the measures had an effectiveness level of 72%.



# From theory to practice

## Ecuador: diagnosis using empirical and scientific data

The International Potato Centre (CIP) and the Inter-American Institute for Cooperation on Agriculture (IICA) are implementing the EUROCLIMA+ project “Andean Resilience: Biodiversity and good practices in climate-smart agriculture to improve resilience and productivity of family agriculture in potato-based Andean food systems,” working with over 1,500 families.

The participatory baseline assessment provided information regarding the central mountain region of Ecuador (covering the Tungurahua and Chimborazo provinces). Based on this information and local farmers, an agenda of good agricultural practices adapted to the region’s climate risks and contributing to climate change mitigation was developed. The process included three phases:

1. Climate vulnerability and risk assessment;
2. Carbon footprint assessment; and
3. Identification of climate-smart agricultural practices.

The guiding principles of the process are the IPCC’s (2014) concept of climate risk and the publication “Tools for incorporating climate change criteria in territorial development and land-use plans,” developed by Ecuador’s Ministry of the Environment (MAE, 2019), which addresses three critical climate hazards for the zone of intervention: frost, extreme temperatures and heavy rain. These tools are applied using scientific resources and other available resources.



Source: Escobar, J. et al. 2021

The vulnerability of the potato farms is calculated based on seven indicators, while their adaptive capacity is calculated based on nine indicators. Information regarding socio-economic factors, such as the level of organization, educational level and access to markets and financing, is considered in identifying agricultural practices. The Cool Farm Tool, developed by the University of Aberdeen (Cool Farm Alliance, 2019), is applied to the plots of 31 families, considering seven variables. The data collection results in the field are analysed together with key stakeholders from academia, research institutions, and farmer representatives.

Escobar, J. y Velasco, C. 2020.

## Lessons learned

Existing and available scientific resources and data should be utilized.

Empirical data should be incorporated.

Finding the right balance between scientific rigor and pragmatism is a challenge.

Key groups (producers, technicians and local government personnel) still have a somewhat limited concept of climate change. The data collection process should include an educational dimension to ensure the stakeholders understand the issue and participate adequately.

Intergenerational and gender approaches should be included in the process:

- Traditional gender roles still exist among the farming families, whereby the man is generally in contact with the farmer organizations, marketing networks, etc., and is the primary decision-maker.
- There are youth motivated to renovate their parents' farms or plots. Including them in the data collection and the project, through intergenerational activities, is critical to ensure that the farms are taken on by the next generation and foster changes and improvement in the full participation of women.



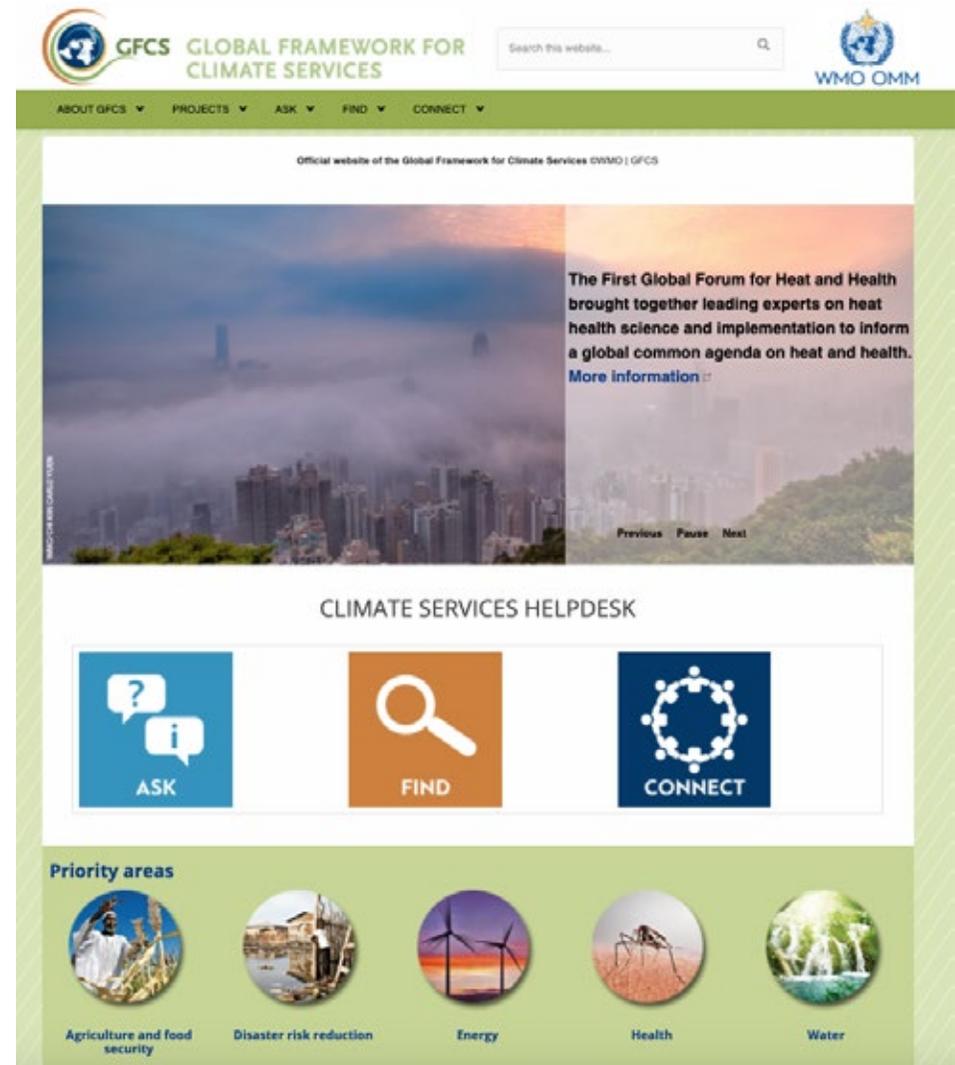
## Climate services: information for decision-making

Sound climate information products include a broad range of products, from global and regional climate models through the outputs of local impact and vulnerability assessments. Generating such products requires data and information from diverse fields of research. Climate information can describe historical, current, and future climate conditions. It can forecast and project future conditions in monthly, seasonal, or decade-long outlooks and their impact on natural and human systems. Climate services generate and supply this information to a wide range of users to support climate-resilient development. The scope and details of such services must be determined in close collaboration with the users.

‘Adapt to what, exactly?’ This is the first question that a decision-maker might ask him or herself when faced with the need to prepare for the consequences of climate change. Without knowing what changes are expected in the climate, it is difficult to choose an adaptation approach ahead of those expected changes proactively. Although measures can be selected based on experienced climate changes, the more one knows about the future impacts; the better one can design effective response mechanisms. As such, both information and climate services are needed as foundations for risk management and decision-making.

Providing climate services is a rapidly growing field that involves a variety of actors, from national research institutions and national meteorological and hydrological services (NMHSs) to operators of regional and global information platforms. In recent years, efforts have been increased to tailor climate information, customizing it according to the specific needs of the users. The formal framework of the United Nations that supports the development of climate services is the Global Framework for Climate Services (GFCS), headed up by the World Meteorological Organization (WMO).

Due to differing perspectives, there may be a discrepancy between what the providers and the climate services users consider helpful information. This may be because information providers are not familiar with the users' decision-making contexts and processes, or it may be because decision-makers cannot process the climate information in the form in which it is provided. The level of uncertainty associated with specific projections is another critical factor. As such, dialogue and exchange of ideas between providers and users of climate information are critical (GIZ, 2021).

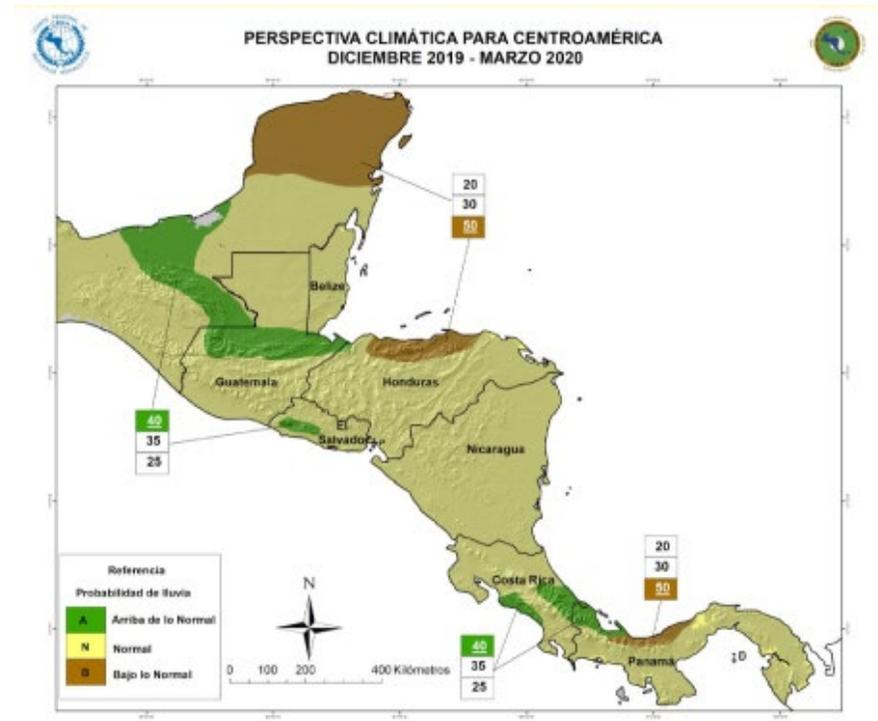


Source: <https://gfcs.wmo.int>

Case study:

# Developing monitoring systems for extreme events and drought in response to climate service needs for food security

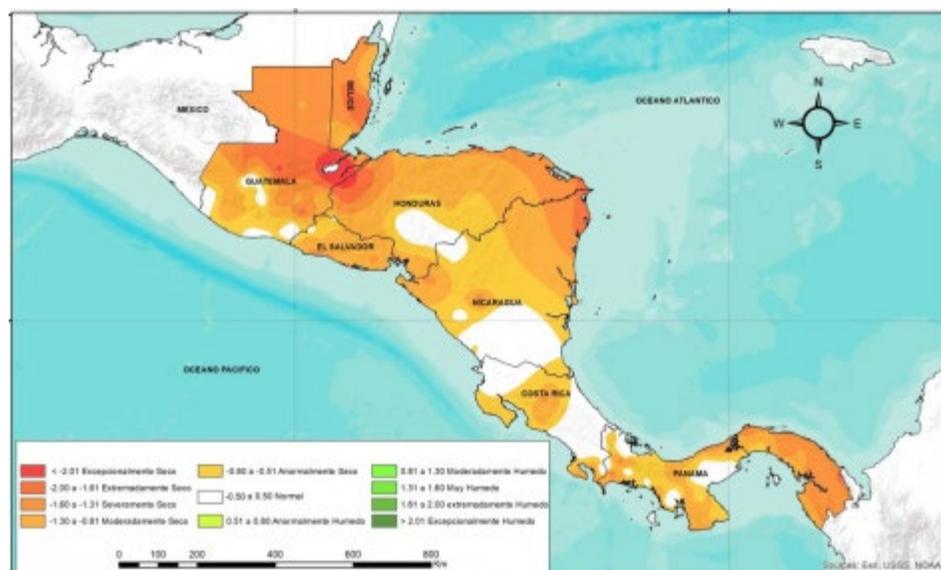
The Regional Committee on Hydraulic Resources (CRRH) was established in 1966 as a coordinating agency for the meteorological services of the Member States of the Central American Integration System (SICA). The CRRH possesses solid expertise, with Central American specialists in meteorology, hydrology, climatology and climate change. The institution does not have its personnel but instead works with designated specialists in the different countries, grouped into technical committees that meet on an as-needed basis. Information is collected at validated weather stations (with regular quality control checks) in each country. The rules for exchanging information between the CRRH and the technical teams of each country, responsible for obtaining data and conducting quality control, are defined by a protocol. Like other SICA entities, the mission of the CRRH is to support the meteorological organizations of the Member States, not to replace them. Although the final beneficiaries are the people, the primary users are the governments, which can use the information provided to plan public policy, issue weather warnings or apply instruments in response to climate events.



Translation of text on the map, page 15 of the PDF:  
Title: Climate Outlook for Central America, Dec. 2019 – March 2021  
Key: Probability of rain Above normal, Normal, Below normal  
[www.centroclima.org](http://www.centroclima.org)



Source: <https://centroclima.org/>



Source: LVIII Foro del Clima de América Central. CRRH/SICA.

The CRRH carries out the following activities:

- Monitoring the occurrence of precipitation, based on the Standardized Precipitation Index (SPI), every three months.
- Developing are scenarios based on past and future forecasts. The CRRH began developing these outlooks in 2000, publishing two outlooks per year (in April and in June). As of 2002, it began issuing three outlooks per year, in April, July and November. To date, 60 climate outlooks have been issued for Central America.
- Developing hydrological outlooks, with forecasts for the countries' main watersheds and river flows (depending on the countries' capacities to conduct the necessary monitoring). The Central American Hydrological Forum is responsible for generating this information.
- **Forum on the application of climate forecasts to food and nutritional security**, organized by the Information Systems for Resilience and Food and Nutritional Security Program of the Central American Integration System (PROGRESAN-SICA) in collaboration with the CRRH, a five-month process carried out by specialists in water and sanitation, health and nutrition, agriculture and coffee farming, and fishing and aquaculture in which they prepare risk scenarios for each sector.



- Publishing a journal monitoring El Niño climate patterns. It was developed for two areas in Central America with support from FAO. Today, ASIS information is available on FAO's Earth Observation Platform. (For further details, see the next section.)
- **Developing the Virtual Severe Weather Centre and the Drought Monitoring System. (The latter is a project supported by the EUROCLIMA+ programme).**

The CRRH produces considerable information, but its mandate does not directly include disseminating that information to the public. However, the Climate Centre Platform (see Centro Clima – Plataforma Regional de Información Climática), which is managed by the CRRH and by the meteorological services of the Central American countries and the Dominican Republic, is a regional portal that provides users with climate information that supports decision-making to reduce the effects of climate variability and climate change in the agriculture, food security, biodiversity, fishing, coffee production, water, energy and risk management sectors.

Effective multisector partnerships should be developed with key decision-makers and stakeholders in the agricultural and agroforestry sectors and those responsible for disaster risk reduction and water management to raise awareness of the existence of these tools and use the information they generate.

Source: Olmedo, B., 2020.

## Case study

# Monitoring drought in Central America using the ASIS platform

Fifty-nine percent of the agricultural losses resulting from natural disasters in Latin America and the Caribbean are caused by drought. The Agriculture Stress Index System (ASIS) focuses on the effects and damages to crops caused by drought and identifies agricultural areas highly prone to drought. Every ten days, two satellites of the United States National Oceanic and Atmospheric Administration (NOAA), equipped with Advanced Very High-Resolution Radiometers (AVHRR), collect data on the health of the vegetation (Vegetation Health Index, or VHI) and the skin temperature of the ground (Land Surface Temperature, TCI), at a resolution of 1 km. The information gathered is analyzed and compared to precipitation data from the area to determine if there is water stress (resulting from drought) or any other type of stress (such as pests), to provide the users with climate services, including the following:

- Information on the start and end of the sowing period;
- Inputs on the development of crops during the agricultural cycle;
- The probability of drought at the end of the agricultural cycle;
- Actual drought events occurred (30-year historical records);
- Data search by index, crop, cycle and date.

The ASIS system generates data by country, department/province, and municipality/district/canton (depending on the administrative divisions of each country). It produces information by type of crop and agricultural cycle. In Central America, the implementation of the system is split into two significant areas of surveillance (the Central American dry corridor and Central American basic grains). It is coordinated by an interinstitutional group comprised of personnel from agriculture and environment ministries, meteorological institutes, and other potential users such as emergency commissions and agricultural insurance companies. In each country an administrative entity has been designated to head up the work with ASIS (see the table below).

### ASIS administrative entities in Central America

LOCATION	LEVEL	ADMINISTRATIVE ENTITY	YEAR
NICARAGUA	Nacional	Instituto Nicaragüense de Estudios Territoriales -INETER	2017
EL SALVADOR	Nacional	Ministerio de Medio Ambiente y Recursos Naturales-MARN	2019
GUATEMALA	Nacional	Instituto Nacional de Sismología, Vulcanología, Meteorología e Hidrología-INSIVUMEH	2019
HONDURAS	Nacional	Secretaría de Agricultura y Ganadería -SAG	2019
PANAMÁ	Nacional	Ministerio de Desarrollo Agropecuario -MIDA	2020



## CONCLUSIONS

The interests of the different family agriculture systems in obtaining a vulnerability baseline may differ and may depend on their available resources, particularly their access to climate information. Despite these differences, three key steps should always be taken in preparing for and implementing such an assessment:

1. **Determine the objective of the vulnerability baseline.** The purpose determines the level of detail necessary in the assessment. The aim can be to identify the different elements that determine vulnerability to estimate their importance and magnitude and consider them when selecting adaptation measures. Or the objective might be to monitor the outcomes of the adaptation measures implemented to determine their impact and share the experience at other levels.
2. **Determine the specific variables that will be assessed, the level of detail and the method,** depending on the objective and the available resources: diagnosis and review of public information, reflection on target groups, community work, etc.
3. **Adapt the theoretical concepts to the conditions of the rural communities,** move from theory to practice, and develop and apply practical tools. To do this, it is necessary to:

- Be very familiar with the target group, build trust between the families and the project personnel, encourage the participation of the target group by providing them with outputs that are valuable to them, and adapt the language to the context of the target population;
- Empower the rural families through participatory processes and incorporate gender equity and generational renewal into the process;
- Involve the local authorities to have their backing from the start of the process and support the institutionalization of the achievements (for example, monitoring the impacts of the adaptation or mitigation measures).

Working with rural communities generally involves high financial and time investments in technical personnel, transportation, workshops, and meetings. Being creative in selecting the tools for this process should go beyond the tools used in the past. To the extent possible, virtual tools should be considered, particularly for follow-up, sharing results and monitoring:

- Review online databases and open access virtual tools to reduce the costs of collecting and processing information.

- Work with promoters in the communities, such as community leaders (youth) and professionals from organizations providing extension services.
- Use electronic devices to facilitate recording data in the communities and subsequent data processing.
- When creating the assessment team, choose individuals with complementary experience and expertise that is pertinent to the objective of the assessment, who will support the promoter by providing information through virtual means.

Public, private, and scientific institutions produce a great deal of technical information to support decision-making and the design, planning and implementation of public policies in Latin America. However, the key stakeholders in different sectors are largely unaware of this information.

It is essential that effective partnerships and intersectoral channels of communication be developed to disseminate information about these sources of information, train users in their use and strengthen institutional capacity within the governments, to ensure the long-term management of these platforms.



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