

# Vulnerability assessment and decision support systems for climate risk management



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Rodney Martínez Güingla  
[r.martinez@ciifen.org](mailto:r.martinez@ciifen.org)



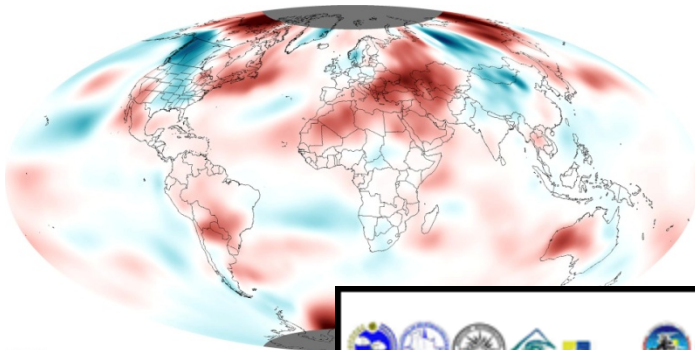
**Does this family interested about the flooding was caused by the climate change or the climate variability?**



**No.** This family needed to avoid the flooding or at least be prevented to react. This is not only a climate related matter.

**We need to have public policies, translated in effective actions. For that, decisions in the ground should be made on the basis of good and opportune information about CLIMATE, VULNERABILITY AND IMPACTS**

# A lot of efforts on climate information...Is that enough?



October 2012  
NOAA climate.gov



**Pronóstico Estacional Oeste y Sur de Sudamérica Abril-Junio 2012**

**1. Situación general**

El análisis estadístico de 430 estaciones de los Servicios Meteorológicos de Argentina, Bolivia, Chile, Colombia, Ecuador, Perú, Uruguay y Venezuela, indica que durante el periodo Abril-Junio 2012 existen mayores probabilidades de lluvia por encima de lo normal en la mayor parte de Venezuela, Colombia, Costa central y Sierra central y sur de Ecuador, Sierra norte y central de Perú, noroeste de Argentina y norte de Uruguay. Mayores probabilidades de lluvia bajo lo normal al norte de Ecuador, mayor parte de Bolivia y Provincia de Buenos Aires y noroeste de Argentina. Mayor probabilidad de que la Temperatura Máxima se presente por encima de lo normal en la Sierra norte y sur de Ecuador, Costa norte y central de Perú, la mayor de Bolivia, zona central y sur de Chile y la Provincia de Buenos Aires y sur de la costa de la Patagonia en Argentina. Se reducen probabilidades de Temperatura Máxima por debajo de lo normal, en la mayor parte de Colombia, norte de Ecuador, Sierra central de Perú, Llanos de Bolivia, extremo norte y austral de Chile, y extremo sur de la Patagonia en Argentina.

**Venezuela**  
Mayor probabilidad de lluvia sobre lo normal en todo el país.

**Colombia**  
Mayoría por los límites de lluvia por encima de lo normal en los departamentos del país.

**Ecuador**  
Mayor probabilidad de lluvia sobre lo normal en la mayor Costa central y Sierra central y sur. Se ven así por probabilidades de lluvia bajo lo normal.

**Perú**  
Mayor probabilidad de lluvia sobre lo normal en la Sierra norte y central. El resto del país con probabilidades de lluvia encima o bajo lo normal.

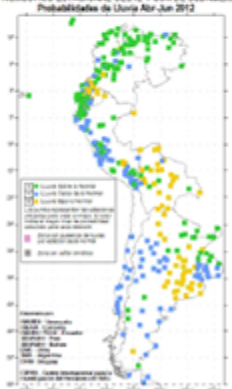
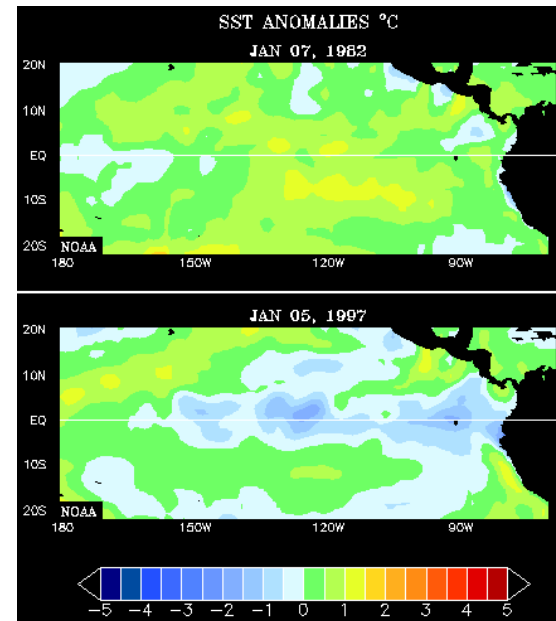
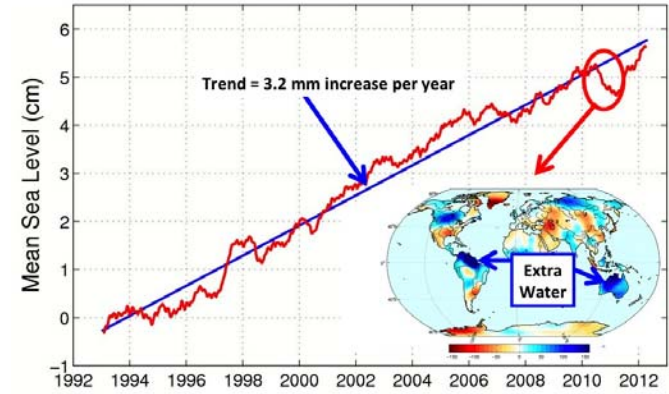
**Bolivia**  
Mayor probabilidad de lluvia bajo lo normal en la mayor parte del país.

**Chile**  
Mayoría por los límites de precipitación en la zona de la Sierra de los Andes y en el resto del país, con mayor probabilidad de lluvia en la zona de la Sierra Central, Sur y Austral.

**Argentina**  
Mayor probabilidad de lluvia sobre lo normal en la Provincia de Buenos Aires y noroeste del país. Mayor probabilidad de lluvia sobre lo normal al noreste del país. El resto del país con probabilidades de lluvia en el rango normal.

**Uruguay**  
Mayor probabilidad de lluvia encima o lo normal al noroeste, el resto con mayor probabilidad de lluvia sobre lo normal.

**Pronóstico Estacional Oeste y Sur de Sudamérica**  
Probabilidades de Lluvia Abr-Jun 2012



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# Number of Climate-related Disasters Around the World (1980-2011)

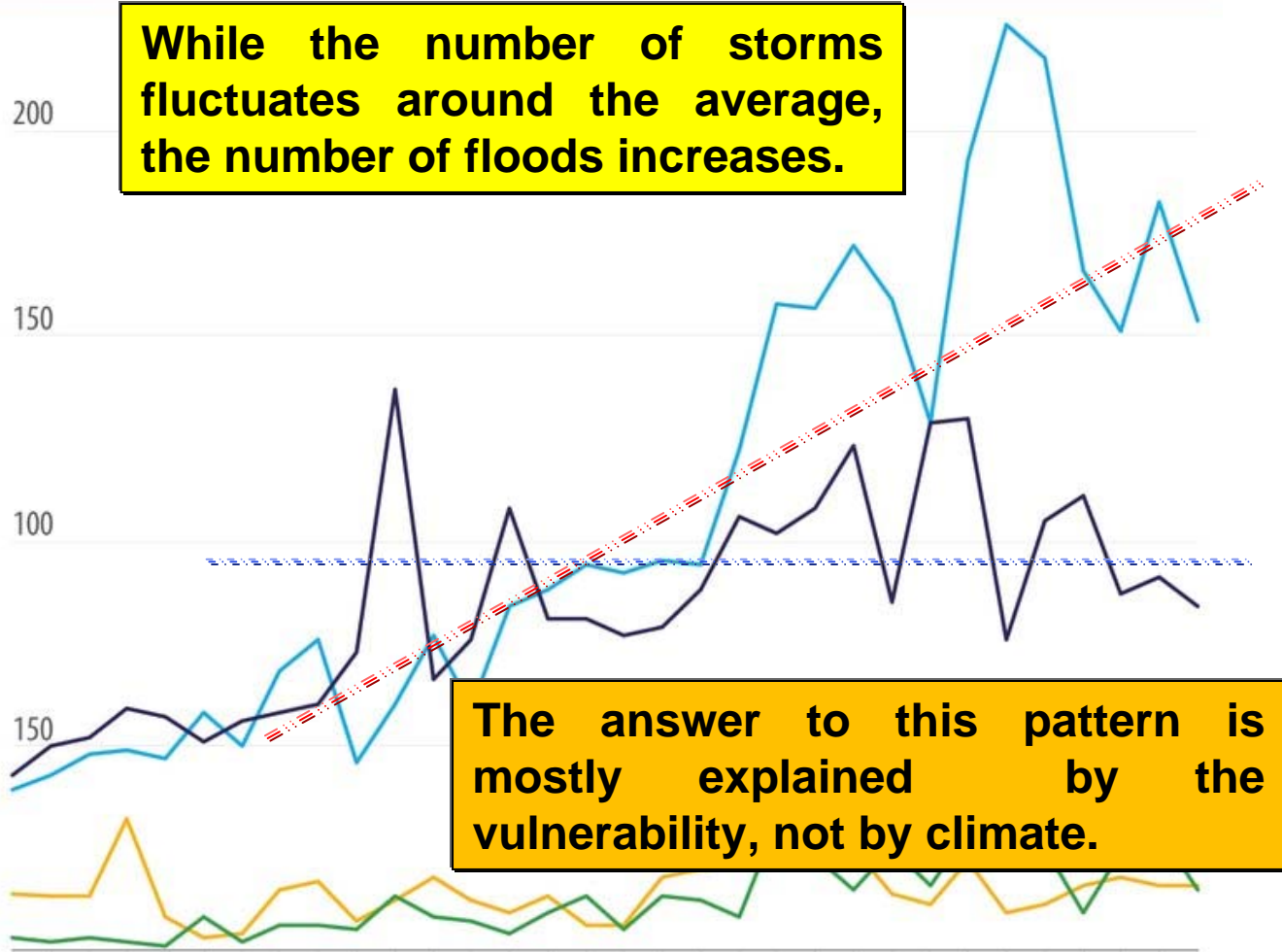
 **3455**  
FLOODS

 **2689**  
STORMS

 **470**  
DROUGHTS

 **395**  
EXTREME TEMPS

**While the number of storms fluctuates around the average, the number of floods increases.**



**The answer to this pattern is mostly explained by the vulnerability, not by climate.**



The United Nations Office for Disaster Risk Reduction  
<http://www.unisdr.org>

Created on 13 June 2012

DATA SOURCES

EM-DAT - <http://www.emdat.be/> - The OFDA/CRED International Disaster Database; Data version: 13 June 2012 - v1207

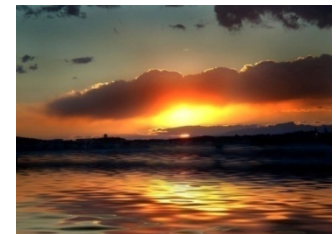
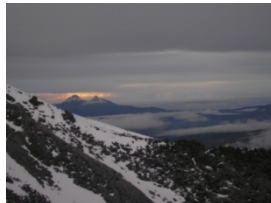
Humanitarian Symbol Set (2008):

<http://www.unisdr.org/map/guideline.php>

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
FLOOD	39	43	48	49	47	51	56	58	60	73	137	66	76	108	81	81	77	79	88	106	102	108	123	85	129	130	76	105	111	87	91	84
STORM	43	50	52	59	57	51	56	58	60	73	137	66	76	108	81	81	77	79	88	106	102	108	123	85	129	130	76	105	111	87	91	84
DROUGHT	14	13	13	32	8	3	4	15	17	7	12	18	12	9	13	6	6	18	20	23	27	22	25	14	11	22	9	11	16	18	16	16
EXTREME TEMPERATURE	3	2	3	2	1	8	2	6	6	5	13	8	7	4	9	13	5	13	12	8	31	23	15	25	16	29	24	25	9	24	29	15

## Climate risk management and adaptation: some principles

1. To understand and estimate the **“Near Climate Change (10-15 years)”** considering this timeframe is consistent with planning and the nearest to the political cycles and decision makers needs.
2. To prioritize the analysis of **indexes derived from observed climate data** rather than climate scenarios or projections (more focus on climate variability is needed).
3. **Present Climate Risk Management** : the best way to implement adaptation.
4. To understand and estimate the present **vulnerability** and its **historical evolution pattern** at local scale.
5. Adaptation to climate change is a **bottom up social construction** that should be implemented by the local communities.





*Vulnerability = [Exposure x susceptibility/Adaptative Capacity ]*

**The Vulnerability is the internal component of risk, then their elements are the only that can be managed. To accomplish that, the vulnerability should be studied and understood**

**LACK OF CLIMATE INFORMATION**

**PUBLIC POLICIES**

**INCREASE OF PLAGUES AND DISEASES**

**ECOSYSTEMS AND BASINS STATUS**

**EXCESS OF FERTILIZERS**

**MARKETS**

**CLIMATE VARIABILITY  
AND CHANGE**

**AGRICULTURE SECTOR**

**LIMITED  
RESEARCH ON  
GENETIC**

**WATER USE CONFLICTS**

**LIMITED TECHNOLOGICAL TRANSFERENCE**

**LIMITED OR INEXISTENT RISK TRANSFERENCE**

**LAND DEGRADATION**



## Why to Assess vulnerability?

- To identify, **the social, economical and environmental elements** that make a community vulnerable.
- To better understand the **dynamics** of these elements over the territory (**SPATIAL**) and along the time (**TEMPORAL**).
- Having a spatial approach of the vulnerability help to risk managers to **prioritize actions** in the ground.
- Having a TEMPORAL approach of the vulnerability help to **prospective risk management**, to **intervene over the critical** elements and assess the **impact** of these actions (INDICATORS).
- To work on risk management based on a comprehensive vulnerability assessment put to risk managers in the way **to solve the structural problems**, not just responding to the emergencies.



## Some considerations:

The assessment of the social, economical and environmental components of climate vulnerability should consider the following criteria:

- To be based on evidences of the historical relationships: **climate-population; climate ecosystems, climate-livelihoods.**
- Identify the **non climate factors** which could influence in the previous relationships.
- **To include** the non climate factores as components of the vulnerability.
- **To weight this factors,** based on the experience of local stakeholders and communities and historical information.

**A LOCAL CASE STUDY**



**“Implementation of an information system on sectoral vulnerability for climate variability and change in Guayas Province, Ecuador”**





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# SOCIAL, ECONOMICAL AND ENVIRONMENTAL COMPONENTS OF CLIMATE VULNERABILITY



$$\begin{aligned}
 V_{SE} = & (V_{AG} + V_{AC} + V_{TUR} + V_{GAN} + V_{IND} + V_{MIN}) - (CA_{CON-MOV} + CA_{ENER} + CA_{ACC\_AG} + \\
 & CA_{PROT\_INUN}) + \\
 & (V_{POB} + V_{SOC-CUL} + V_{SER-BAS} + V_{SOS\_ECO}) - (CA_{EDU} + CA_{SAL} + CA_{ORG}) + \\
 & (V_{FAC-NAT} + V_{FAC-DEGE}) - (CA_{JUR} + CA_{OPE} + CA_{PLAN})
 \end{aligned}$$

CIIFEN, 2012

**Only the integrated approach to the vulnerability can represent the reality and support decisions effectively.**



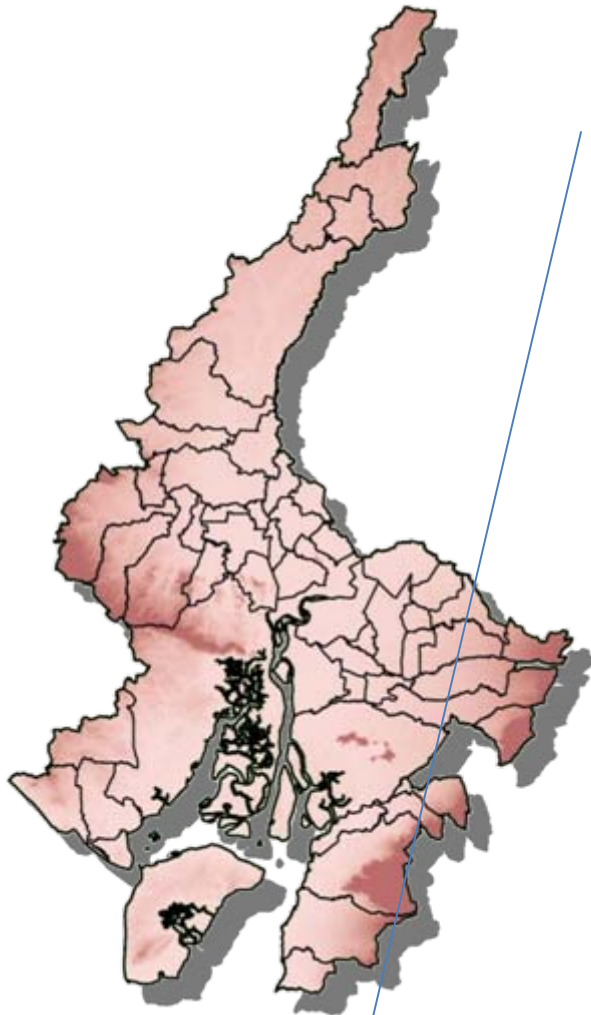
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## ANALYSIS UNITS

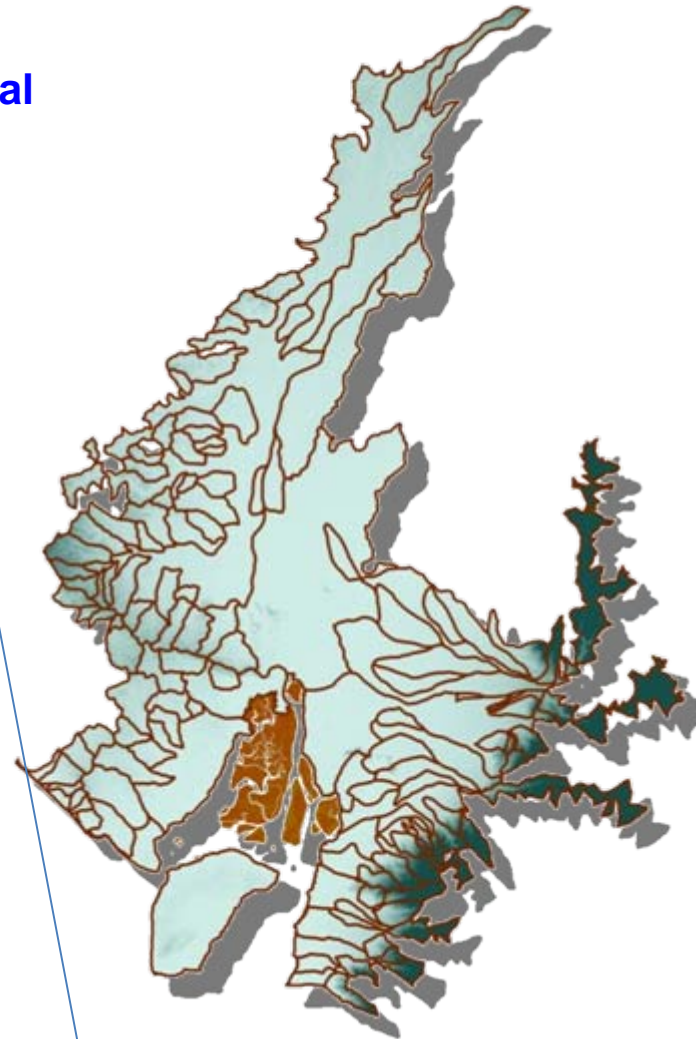
Social and Economical Component

Environmental Component.

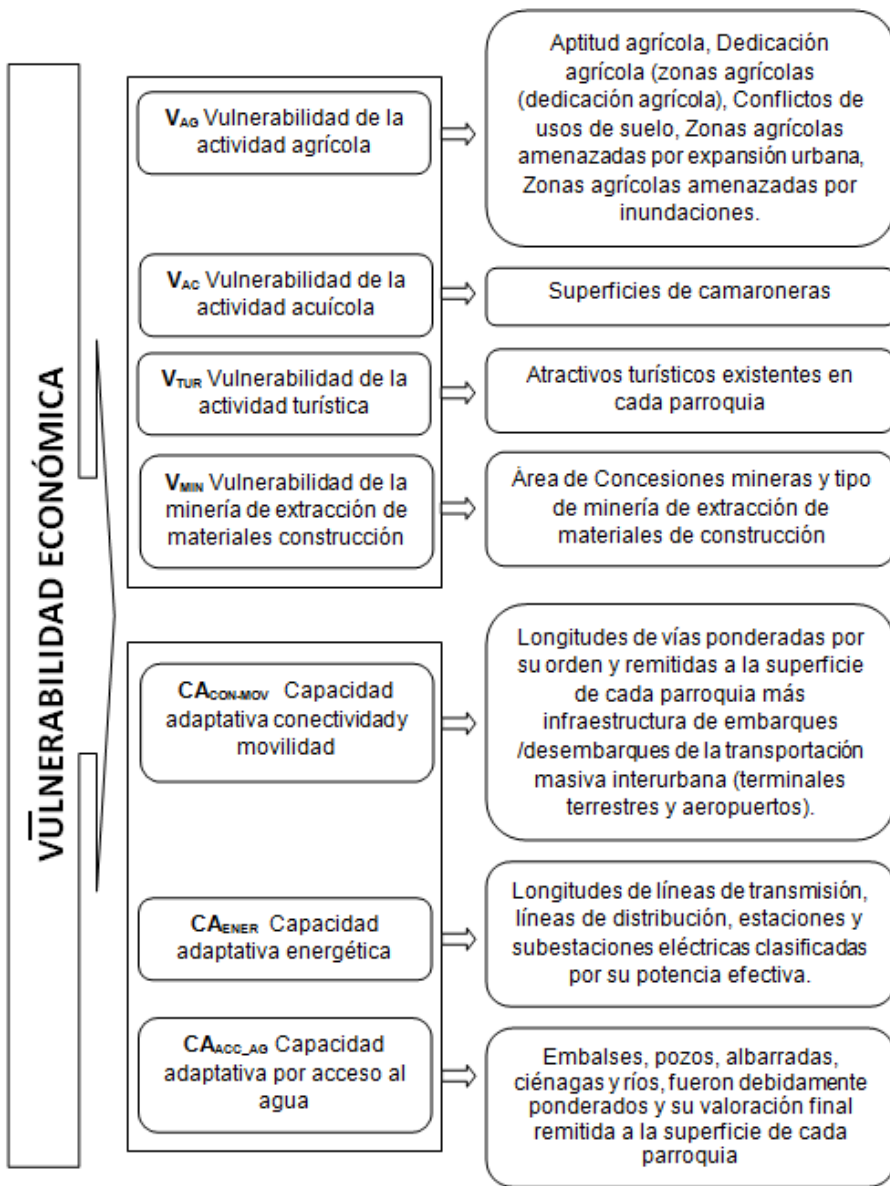
CIIFEN, 2012



Parish level



Micro basins

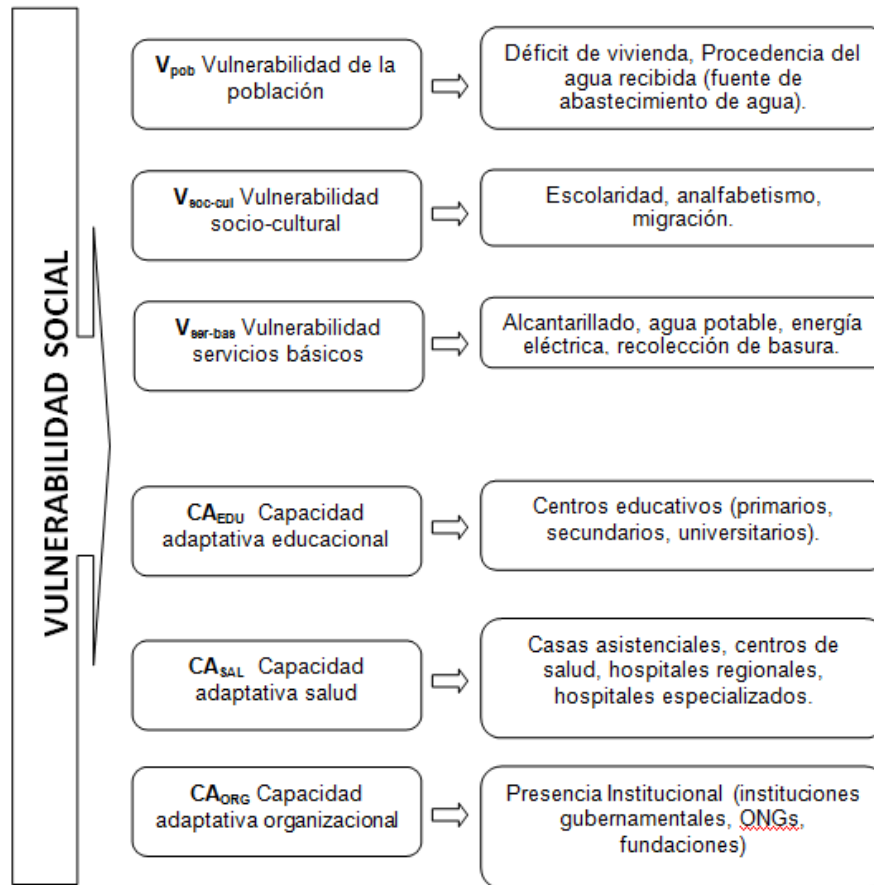


### METHODOLOGY

$$V_E = (V_{AG} + V_{AC} + V_{TUR} + V_{MIN}) - (CA_{CON-MOV} + CA_{ENER} + CA_{ACC\_AG})$$

**V<sub>AG</sub>** = Vulnerabilidad de la actividad agrícola  
**V<sub>AC</sub>** = Vulnerabilidad de la actividad acuícola  
**V<sub>TUR</sub>** = Vulnerabilidad de la actividad turística  
**V<sub>MIN</sub>** = Vulnerabilidad de la minería de extracción de materiales de construcción  
**CA<sub>CON-MOV</sub>** = Capacidad adaptativa conectividad y movilidad  
**CA<sub>ENER</sub>** = Capacidad adaptativa energética  
**CA<sub>ACC\_AG</sub>** = Capacidad adaptativa acceso al agua

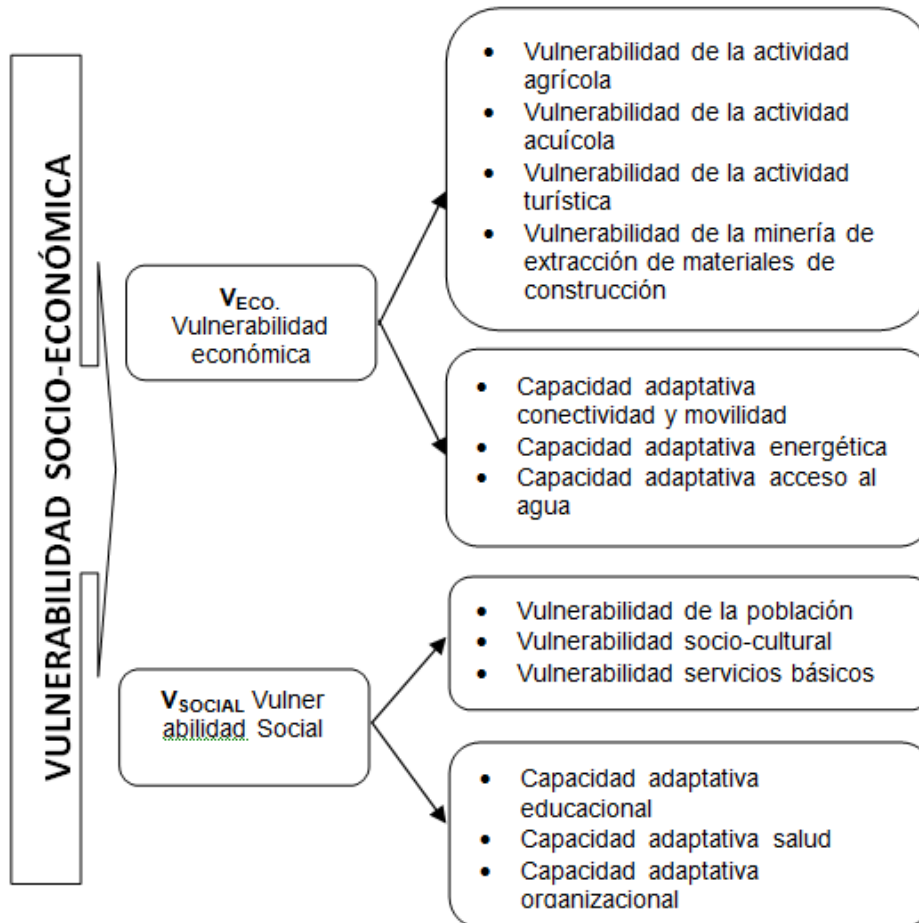
## METHODOLOGY



$$V_S = (V_{POB} + V_{SOC-CUL} + V_{SER-BAS}) - (CA_{EDU} + CA_{SAL} + CA_{ORG})$$

**V<sub>POB</sub>** = Vulnerabilidad de la población  
**V<sub>SOC-CUL</sub>** = Vulnerabilidad socio-cultural  
**V<sub>SER-BAS</sub>** = Vulnerabilidad servicios básicos  
**CA<sub>EDU</sub>** = Capacidad adaptativa educacional  
**CA<sub>SAL</sub>** = Capacidad adaptativa salud  
**CA<sub>ORG</sub>** = Capacidad adaptativa organizacional

## METHODOLOGY

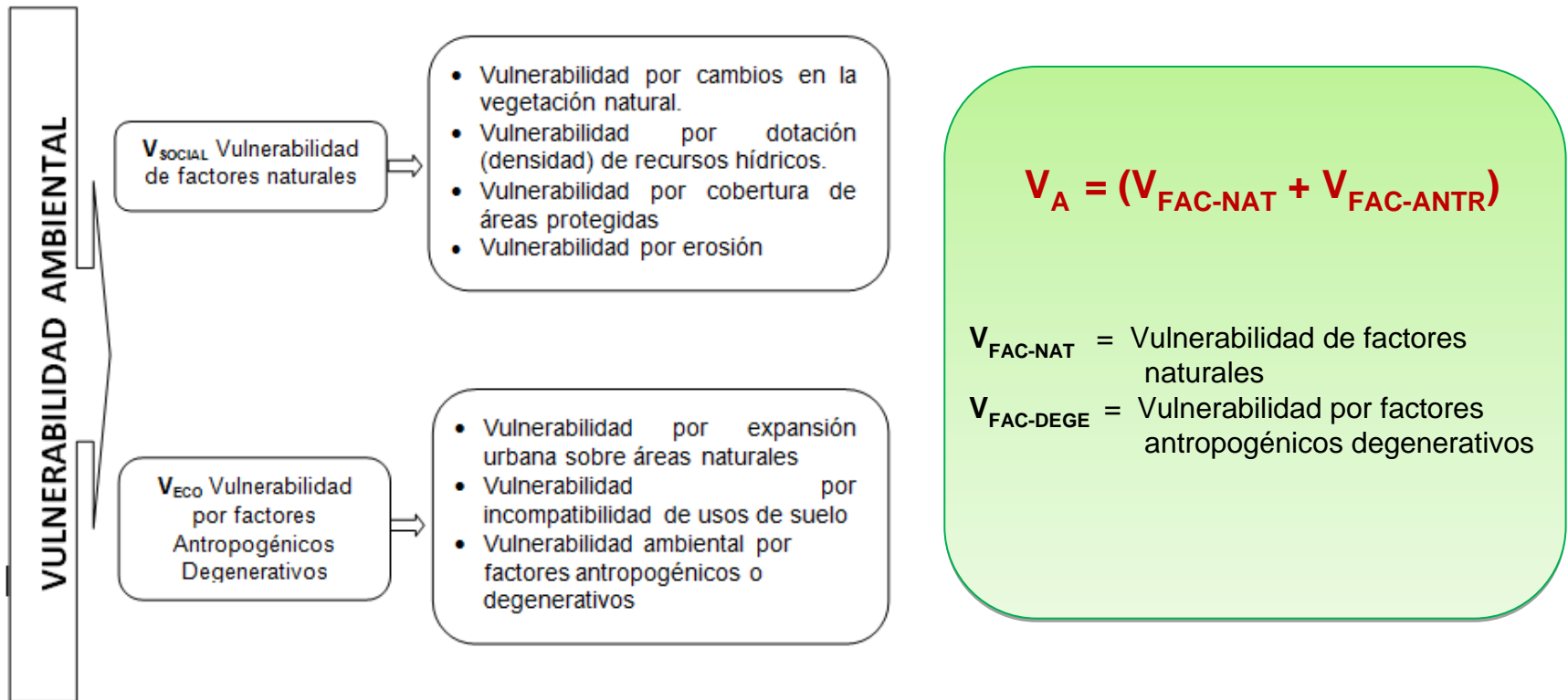


$$V_{SE} = V_E + V_S$$

$V_{SE}$  = Vulnerabilidad socioeconómica  
 $V_E$  = Vulnerabilidad económica  
 $V_S$  = Vulnerabilidad social

CIIFEN, 2012

## METHODOLOGY



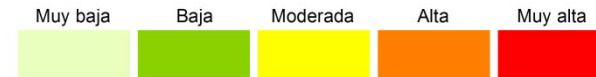


# VULNERABILITY AND ADAPTATIVE CAPACITY COLOR SCALES

Valor	Nivel de vulnerabilidad	Color de representación
5	Muy alta	Rojo
4	Alta	Naranja
3	Moderada	Amarillo
2	Baja	Verde oscuro
1	Muy baja	Verde claro

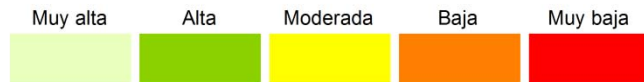
## Vulnerability

Leyenda para la Vulnerabilidad



## Adaptative Capacity

Leyenda para la Capacidad Adaptativa



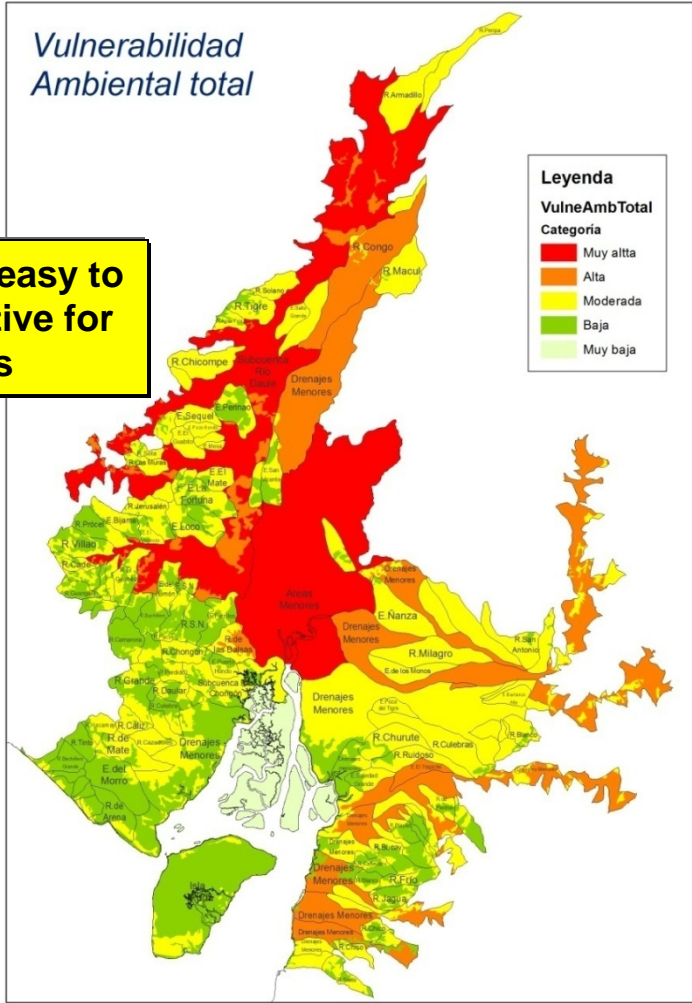
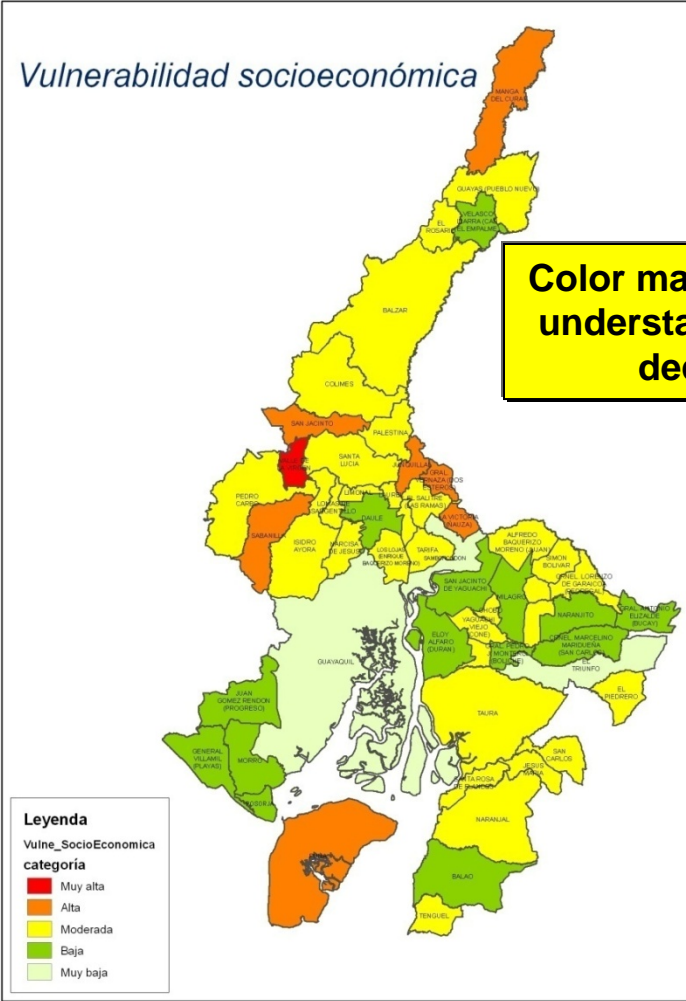
Valor	Nivel de Cap.Adap.	Color de representación
5	Muy alta	Verde claro
4	Alta	Verde oscuro
3	Moderada	Amarillo
2	Baja	Naranja
1	Muy baja	Rojo



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# SOCIAL-ECONOMICAL VULNERABILITY

# ENVIRONMENTAL VULNERABILITY



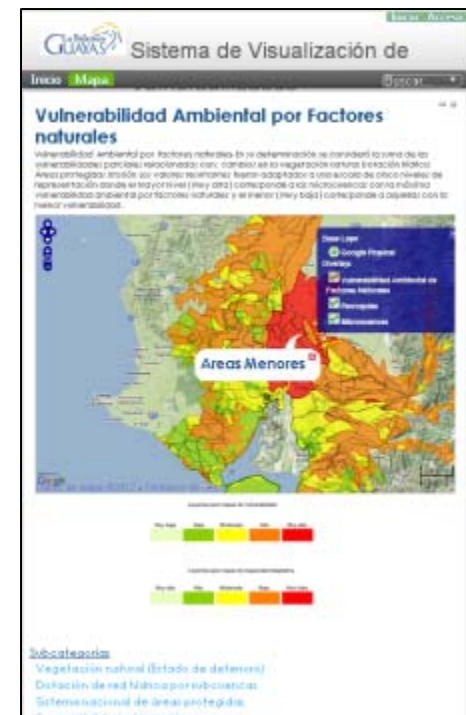
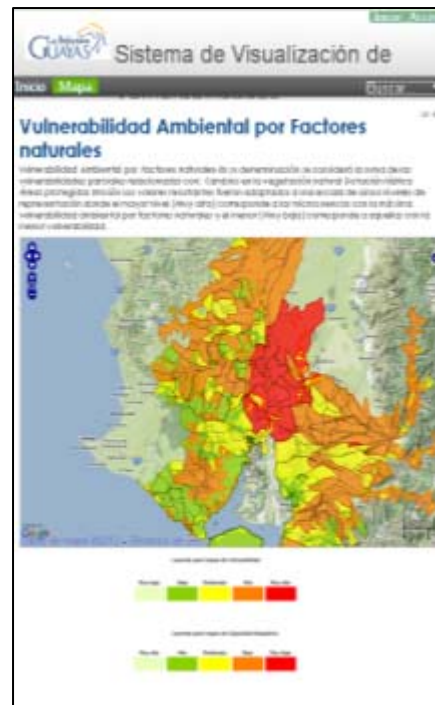
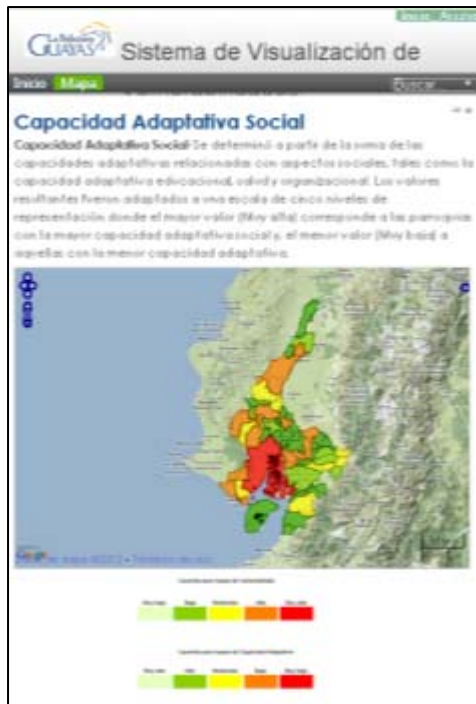
**Color maps are more easy to understand and intuitive for decision makers**

# ONLINE VISUALIZATION SYSTEM



The screenshot shows a web application interface for the 'Sistema de Visualización de Vulnerabilidades' of the 'La Prefectura GUAYAS'. The interface includes a navigation bar with 'Inicio' and 'Mapa' buttons, and a search bar. A login form titled 'Formulario de acceso' is on the left, with fields for 'Usuario' and 'Contraseña', a 'Recordarme' checkbox, and an 'Iniciar sesión' button. Below the login form are social media icons for Facebook, Email, Twitter, Print, and a plus sign. The main content area features a large aerial photograph of a coastal area with a river and fields, captioned 'Vulnerabilidad frente al cambio climático'. Below this are four smaller thumbnail images. The text below the thumbnails reads: 'ESTRATEGIA PROVINCIAL DE CAMBIO CLIMÁTICO FASE I: DIAGNÓSTICO' and 'El Proyecto tiene como objetivo desarrollar un sistema de información de vulnerabilidad climática sectorial de la provincia del Guayas dirigido para autoridades, actores institucionales y comunitarios, que contribuya en el proceso de toma de decisiones para la adaptación y mitigación al cambio climático, con el fin de contribuir en el fortalecimiento de la capacidad adaptativa de la provincia del Guayas para enfrentar los efectos de la variabilidad y cambio climático.'

# Visualization and access to Vulnerability maps





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## AN INTEGRAL APPROACH CASE: COPING TO CLIMATE CHANGE IN THE COASTAL CORDILLERA OF ECUADOR



Since February, 2011, CIIFEN is implementing this project with the support of the Ministry of Environment of Ecuador, The Nature Conservancy (TNC) and the Provincial Governments of Guayas, Manabí, and Santa Elena. It is funded by the European Commission, and aims to support the development and implementation of an integrated response to the impacts of climate change in the Coastal Cordillera of Ecuador. This includes a climate vulnerability assessment, coordination with local authorities, communities and development of local adaptation actions.



The goals of this three year project are:

- a) To improve the current and future understanding of climate vulnerability of the population.
- b) Design a climate change adaptation plan for the Coastal cordillera area.
- c) To strengthen natural resources management with emphasis on dry forest ecosystem to contribute on mitigation and risk management.





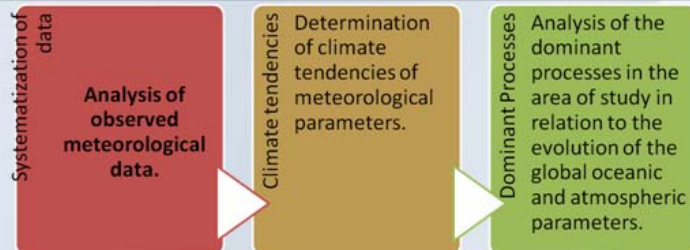
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# Vulnerability assessment

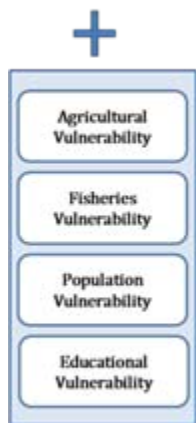
## Participatory process



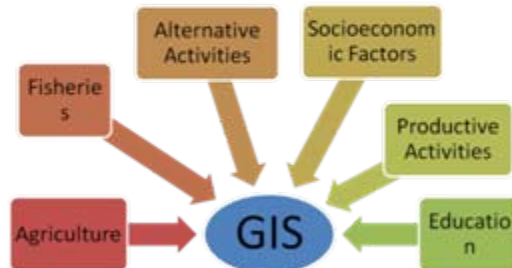
## Climate Analysis



## Vulnerability assessment



Socioeconomic Vulnerability



=





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## UNDERSTANDING CLIMATE VULNERABILITY AND IMPACTS ON THE AGRICULTURE SECTOR IN THE ECUADORIAN ANDEAN REGION AND WATERSHEDS OF CHONE AND PORTOVIEJO



**Proyecto**  
Adaptación al Cambio  
Climático - PACC

The project “Adaptation to Climate Change Through effective Water governance in Ecuador - PACC” is implemented by the Ministry of Environment,

and aims to reduce Ecuador’s vulnerability to climate change through the efficient management of water resources. It is funded by the Global Environmental Facility (GEF) and the Government of Ecuador. The project is implemented, by the Ministry of Environment of Ecuador (MAE). CIIFEN was in charge to conduct a climate-agriculture risk analysis to cope with Climate Change in the Andean region and Chone river basins and Portoviejo in Ecuador.

The study included the analysis of climate, social and economical variables, land use changes, local consulta-



tion processes and several training workshops for technicians, farmers, and authorities. The final outcome will support decisions of authorities on future adaptation plans in the agriculture sector in Ecuador.







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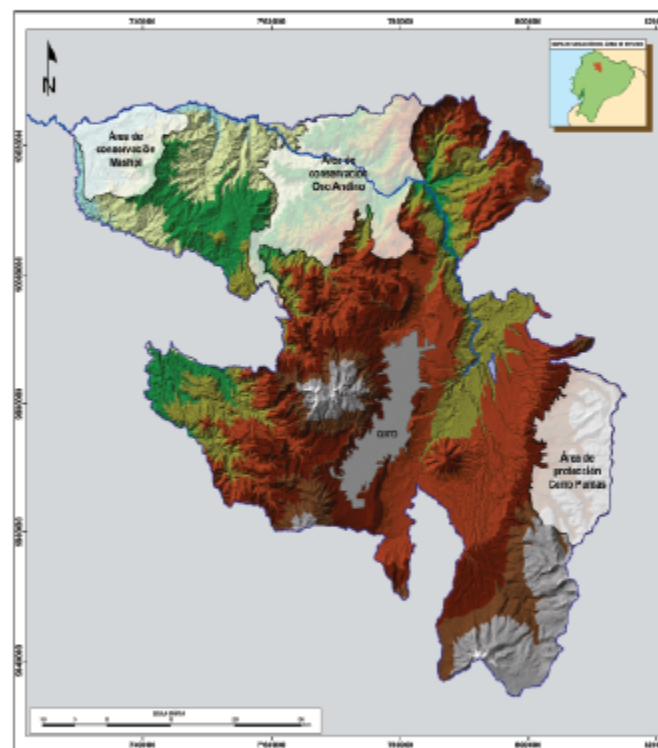
## INTEGRATING CLIMATE CHANGE CRITERIA AND INDICATORS FOR THE CONSERVATION OF THE NATURAL HERITAGE IN THE METROPOLITAN DISTRICT OF QUITO, ECUADOR.



The Secretary of Environment of the Metropolitan District of Quito (DMQ), Ecuador within the second

strategic axis of their Environmental Agenda 2011-2016, had as main target to contribute on the vulnerability reduction to climate change. And contribute on the understanding their causes and consequences.

In this context, and with the support of the World Bank, CIIFEN undertook the design of a proposal to generate information and tools to contribute to the integration



and adaptation of climate change criteria for mitigation and conservation actions of ecosystems and biodiversity of the DMQ, with particular reference to the Metropolitan Protected Natural Areas.



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www.ciifen.org

Documents

Maps

Audio

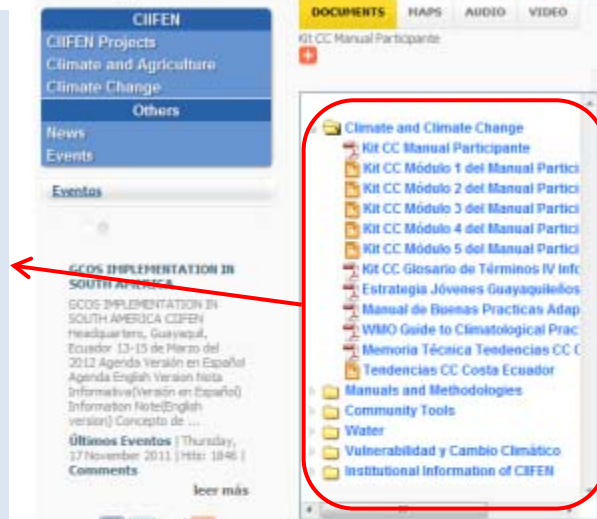
Video

# TOOLS AND RESOURCES



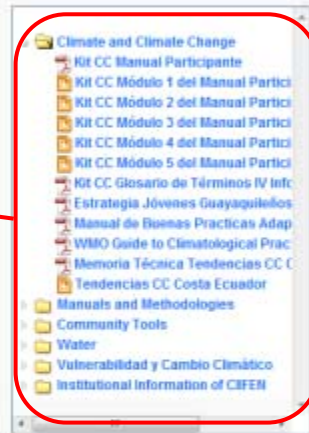
**Documents Tree:**

- Climate and CC
- Manuals and Methodologies
- Community Tools
- Water
- Vulnerability and CC
- Institutional documentation



Summary of each document

Download full document



El cambio actual del clima está asociado al proceso de industrialización que ha originado mayores niveles de consumo de petróleo, gasolina y carbón, la tala y quema de bosques, y algunas actividades agrícolas, generando un aumento significativo en los volúmenes de los gases de efecto invernadero en la atmósfera provocando un calentamiento del planeta.

La reflexión del líder, el aprendizaje y la motivación es muy importante para intercambiar ideas con los demás, cooperando para que se pueda contrarrestar un poco el proceso de contaminación ambiental que sufre en la actualidad la tierra.

La presente Guía "Vulnerabilidad Cambio Climático y Adaptación" recopila conceptos básicos y explica de forma resumida qué comprende el cambio climático, enfocado a la realidad de la costa ecuatoriana, tomando como caso de estudio la RPP Manglares El Salado.



Preliminary view of each document

Descargar

Download pages of the preliminary view

## FINAL REMARKS

- Vulnerability can be assessed including many variables, however, it is better to limit the analysis to few, but **meaningful and verifiable** ones.
- The selection of variables should be supported by the **community and local stakeholders perception** of climate-impacts relationships.
- Vulnerability assessment should not become only a GIS application, **the feedback of the community** must be taken in account for validation.
- The Climate Risk Management (CRM) and adaptation must include **climate related factors and others independent of climate** to be realistic and effective.
- CRM and Environmental management are instruments that contribute with integrated **territorial security** and communities **resilience**.
- To understand the **vulnerability** and estimate its **probable evolution** supports more **effectively** and **efficiently** to **decision making**.

**¡ Muchas gracias !**



**CIIFEN**

[www.ciifen.org](http://www.ciifen.org)

Phone: (593 4) 514770

Fax: (593 4) 514 771

[r.martinez@ciifen.org](mailto:r.martinez@ciifen.org)

Guayaquil, Ecuador.