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Enhancing Adaptation and Resilience to Drought in Dry Tropical Socio-Ecological Systems: The Guanacaste, Costa Rica Example

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Milestones

Hydro-climate variability: analysis of rainfall and temperature sequence from 1977 to present at daily resolution and development of annual rainfall patterns and trends.
Surface water- groundwater systems: 2 Eddy Covariance/ meteorological/ soil sensor stations installed, and 5 stream stage and 3 groundwater level monitoring stations installed in 2 watersheds

Mental models: 40 Interviews completed with local stakeholder groups

Governance: 30 interviews completed

Ecosystem services: 15 meetings with stakeholders and 2 surveys piloted with 10 local farmers and 40 international tourists

Agricultural water and farmer decisions: a bioeconomic mode already developed, for a "model farm" to estimate the economic value of forecast

Publications: poster "Stakeholders' perceptions of social-ecological systems and the information they use in the management of freshwater resources in Guanacaste, Costa Rica" (AGU, December 2015)

Outreach activities: meetings with local people and public agencies; participation in community events and forums; radio interviews, classes at National University of Costa Rica





Our partners-stakeholders

Tempisque Conservation Area (ACT)
NicoyAgua Foundation
Rural Community Aqueduct Managers (ASADAS)
Potrero-Caimital Watersheds Management Commission
Municipality of Nicoya
National University of Costa Rica (UNA)

Special thanks to our collaborators: Costeña S.A and Ingenio El Viejo S.A

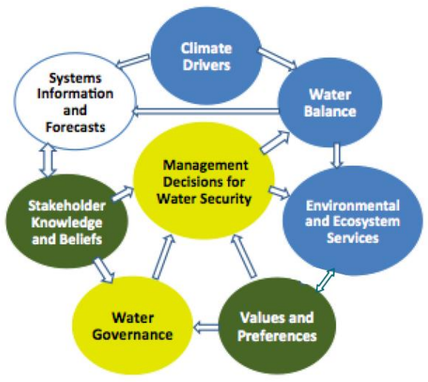
Objective

Support future decisions regarding adaptation to droughts, based on scientific research

Our research

Address current understanding and knowledge of dynamics of key Socio Ecological Systems components

Characterize plausible scenarios and opportunities to build resilience



In progress

Hydrological models:

Model 1: monthly climatological and streamflow data and is implemented using WEAP
Model 2: detailed model representation of a specific watershed with daily streamflow data

Hydro-climate variability: analysis of variability in precipitation and developing scenarios of precipitation change. Expert elicitation process on expected changes in the region's precipitation

Surface water-groundwater systems: analysis of data and additional information about water use

Mental models: Analysis of data gathered from 40 interviews. Second fieldtrip planned

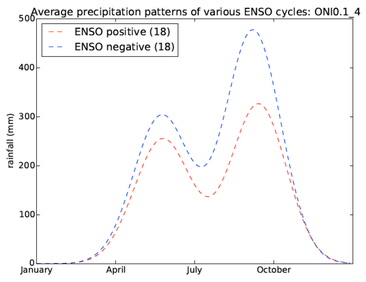
Governance: questionnaire about the usefulness of technical information on climate and water resources and the capacity of organizations to plan and respond to drought. Characterizing linkages across scales to identify key decision contexts and participants

Ecosystem services: analysis of pilot interviews. Second fieldtrip planned

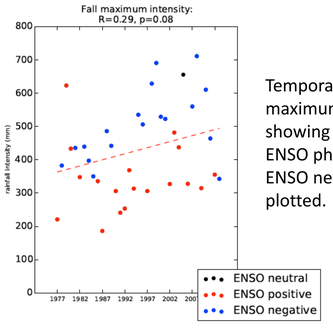
Structured decision aiding: work plan 2015-2016 under revision

Preliminary results

Hydro-climate variability: Short-term rainfall totals show strong spatial and temporal variability. A bi-Gaussian model has been shown to be an excellent representation of annual rainfall variability. Statistically significant trends in components of the annual rainfall pattern have been detected for the summer rainfall peak amount. If any other trends exist, they are obscured by inter-annual variability. This variability is strongly influenced by the ENSO phenomenon (El Niño & La Niña - Southern Ocean Oscillation). It is anticipated that the Bayesian approach will allow to develop ENSO indices optimized to Guanacaste rainfall.



Double Gaussian fitted to Nicoya rainfall data from 1977-2012 for ENSO negative (blue) and positive (red) years. ENSO Year classification is optimized to achieve maximum separation.



Temporal trend of fitted fall maximum rainfall at Nicoya showing dependence on ENSO phase. The single ENSO neutral year is not plotted.

Surface water- groundwater systems: time series data to date reflect the relatively dry period from June to August. Increase in (heavy) rainfall events starting September, related increased discharge as well as increase in groundwater levels was observed. Discharge response to rainfall events is flashy, and high flows often only last some hours, before the river is again dominated by (low flow) baseflow.

Mental models: almost all stakeholders across groups had heard of and understood climate change to some extent. Perceptions of current and future seasonal/yearly patterns varied in detail between stakeholder groups with government agencies, larger farms, and hydroelectric managers relaying more detailed descriptions. Trust in the main provider of climate/weather information is variable among different stakeholders.

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