



# Project: Studies of Climatic Change with adaptation emphasis. Guatemala

Jeffrey Rivera  
Claudio Castañon  
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Guatemala:  
Aprox 108,890 km<sup>2</sup>  
Aprox 13 million people

# Introduction

Many regions in the world, including Guatemala, are facing major challenges in water management.

- Limited hydraulic resources
- Environment quality
- Strategies for the use of water

The conventional simulation models used for the water distributions are not adequate to explore completely the options of the use of resources.

# The project

The Ministry of Environment and Natural Resources through the National Program of Climatic Change and with the support of NCAP (Netherland Climate Assistance program) have made the following project:

Studies of Climatic Change with adaptation emphasis

This project focused on

- examine the relations with the water use
- sustainable development
- consequences of climatic change on the forms of life of the communities

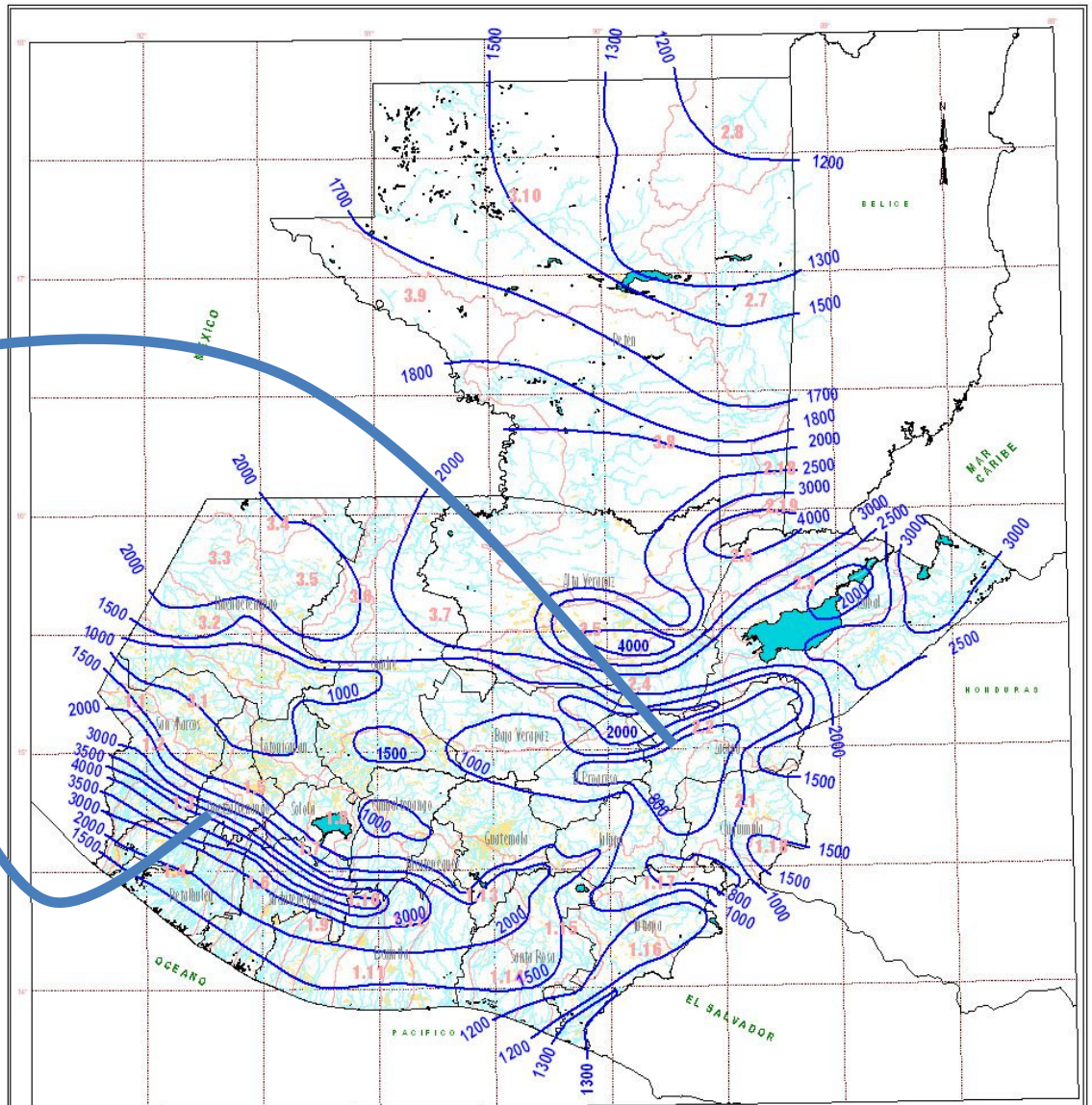


# The objective:

The objective of the project was to consider the technical component oriented toward the development of a tool that can evaluate the impact of climatic change in the hydraulic resources and its associated activities for 2 water sheds in the country, the water shed “Rio Naranjo” and the sub water shed “San Jose” and “Shutaque”. The WEAP model was selected as the tool for these evaluations.

Rain of 700 mm /year

Rain of 5000 mm /year



**REPUBLICA DE GUATEMALA**  
INSTITUTO NACIONAL DE SISMOLOGIA, VULCANOLOGIA,  
METEOROLOGIA E HIDROLOGIA

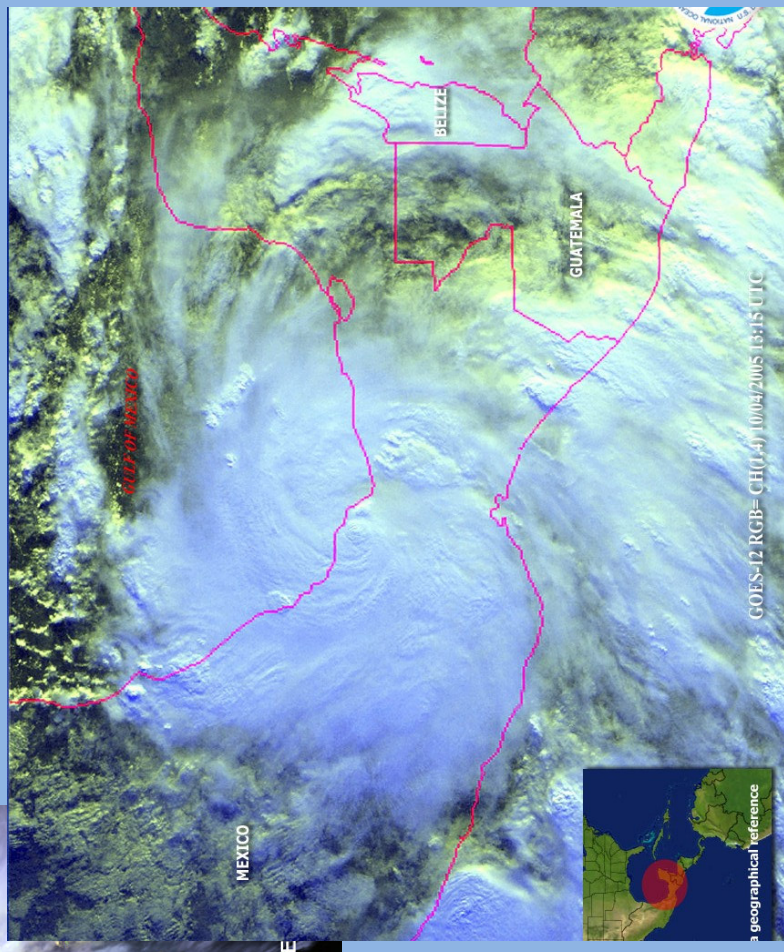
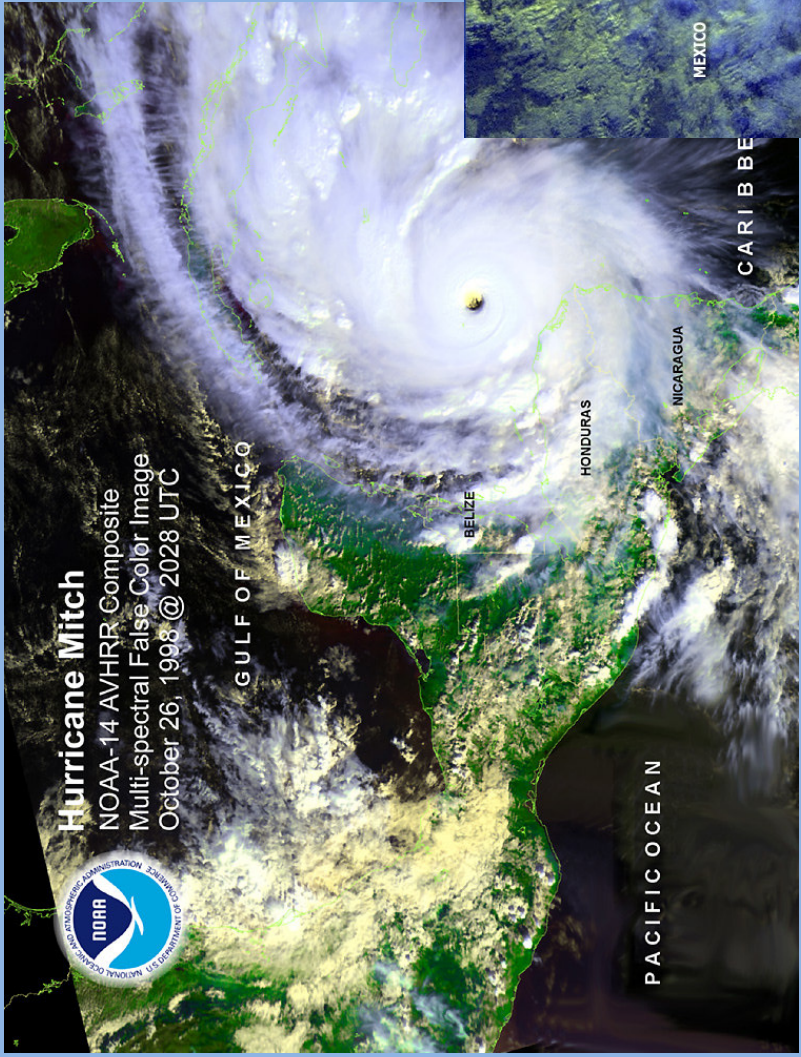


**ISOYETAS PROMEDIO ANUAL**

LEYENDA

- LIMITE DEPARTAMENTAL
- ISOYETA PROMEDIO ANUAL (Dimensional = mm de lluvia)
- LIMITE DE FRECUENCIA Y CODIGO



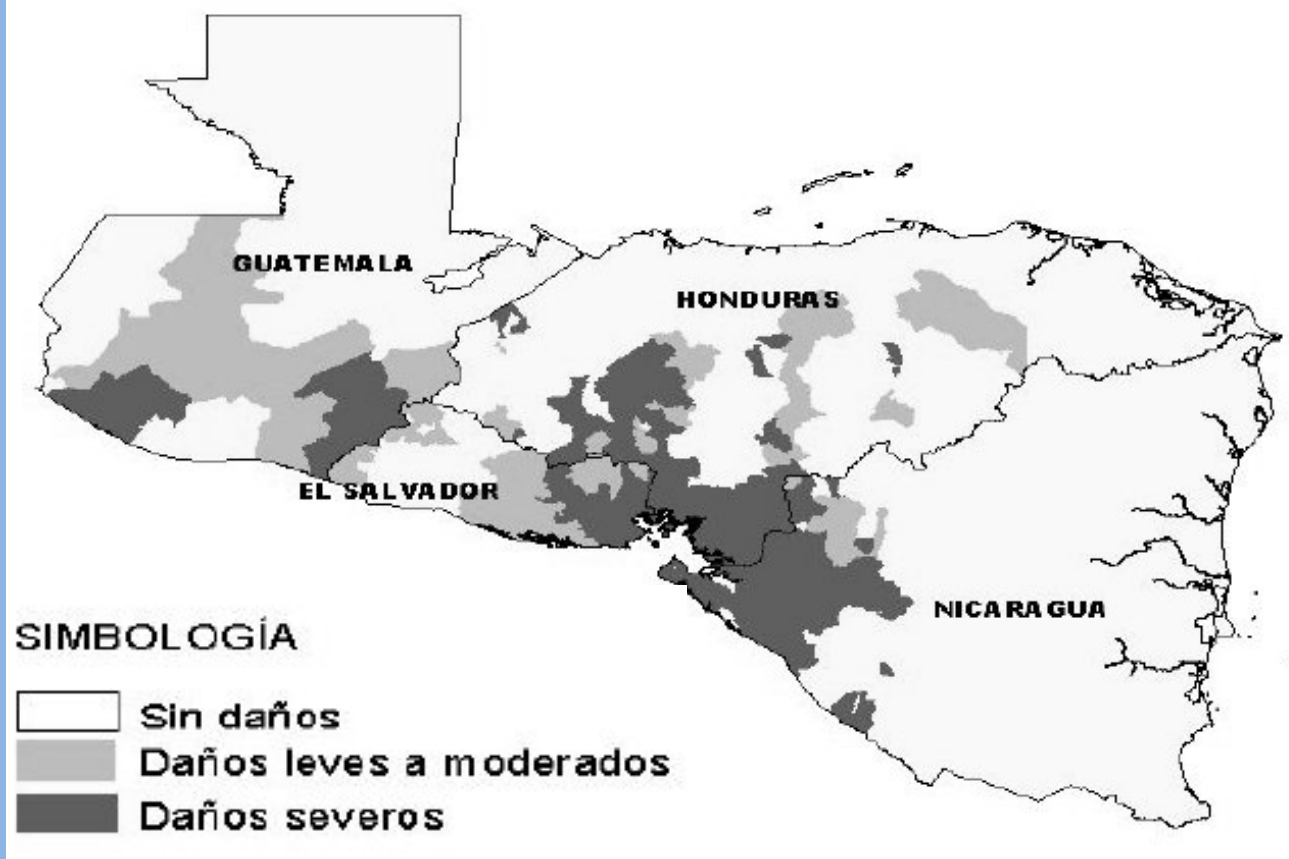








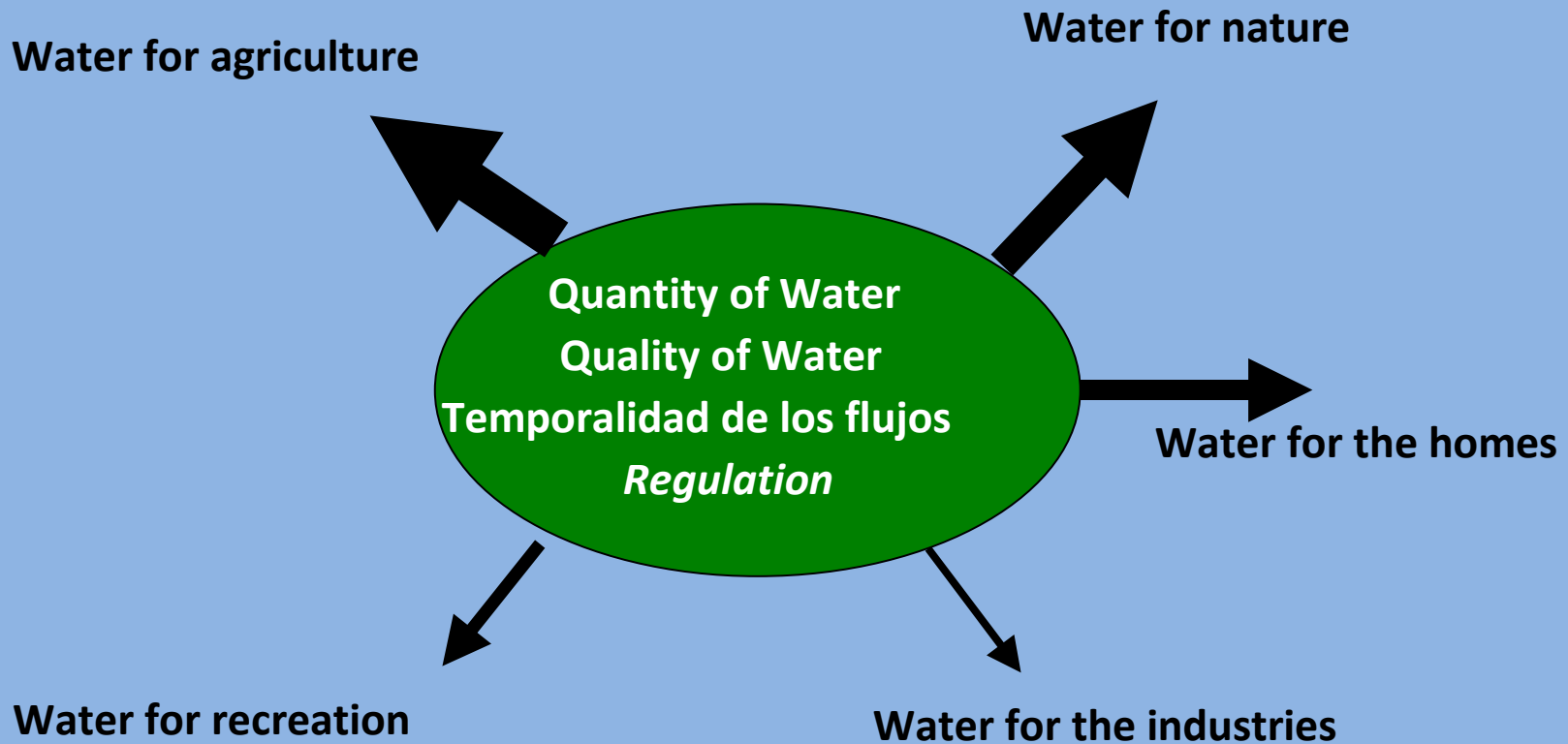
## AFECCIÓN EN LA PRODUCCIÓN DE GRANOS BÁSICOS EN CENTROAMÉRICA, 2001



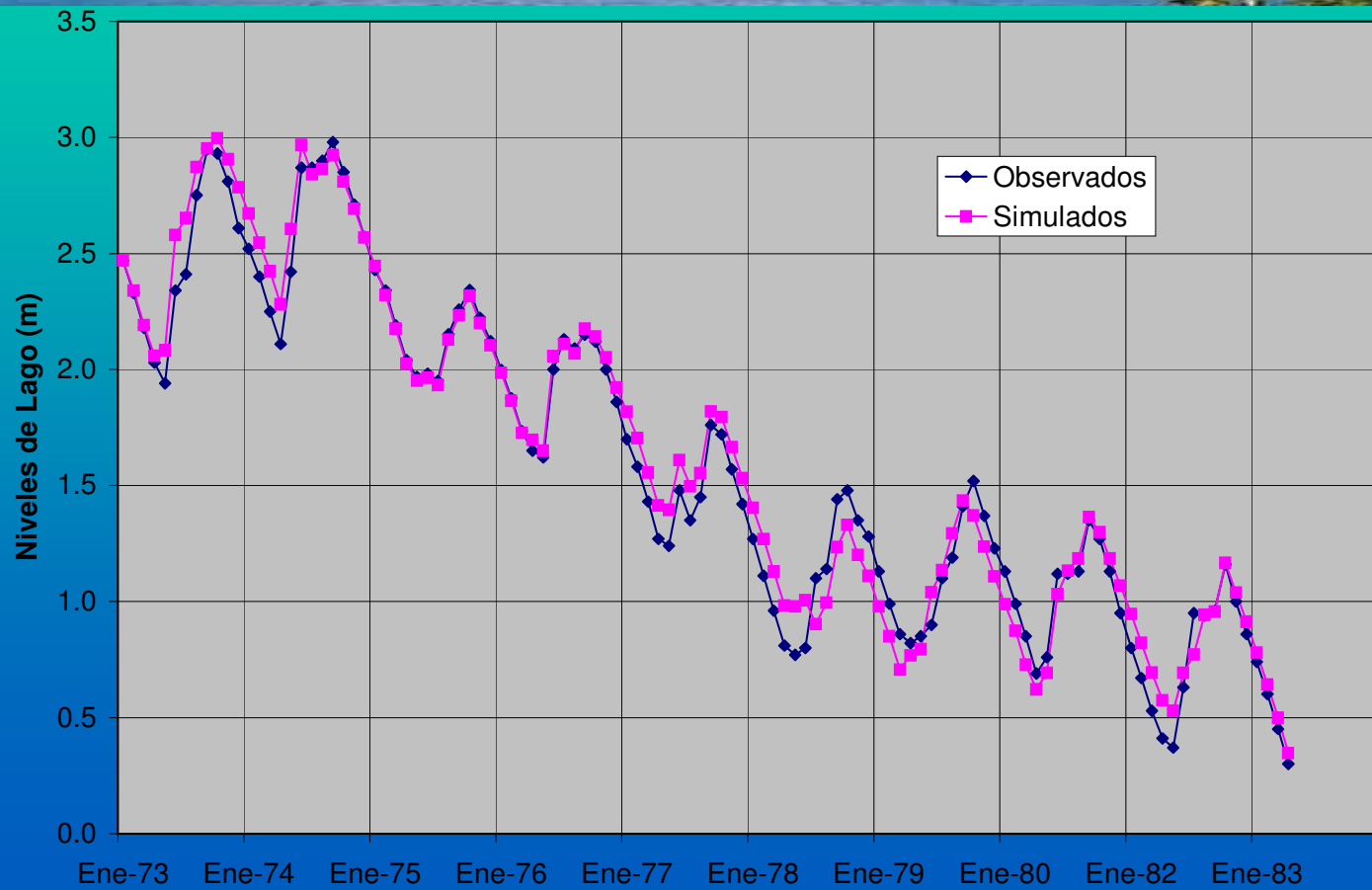
*Fig 8 Daños a la agricultura de granos básicos bajo la sequía de 2001  
(fuente CEPAL 2002)*

# The sectors of Hydraulic Resources

## The different uses of Water



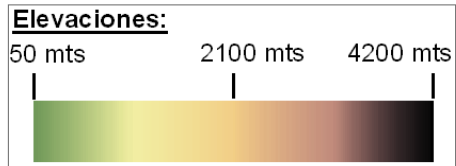
# Case of Lagoon of Ipala





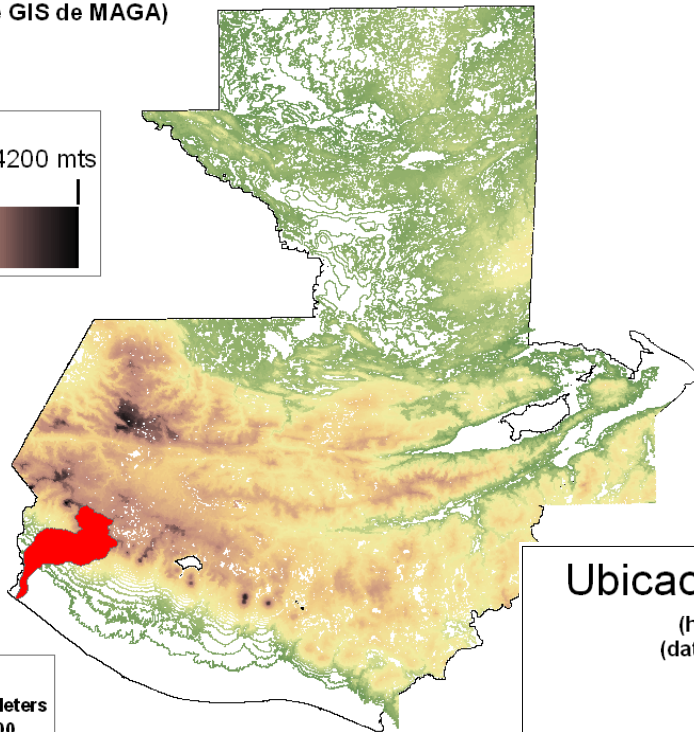
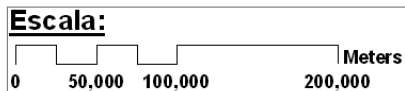
## Ubicacion de Cuenca El Naranjo

(hecho con ArcMAP)  
(datos de GIS de MAGA)



**Cuenca**

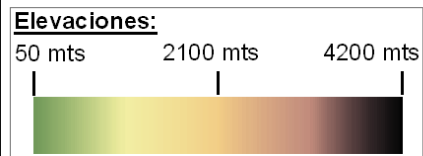
■ Cuenca El Naranjo



**Water shed Rio Naranjo**  
aprox 1255 km<sup>2</sup>  
aprox 272,611 people

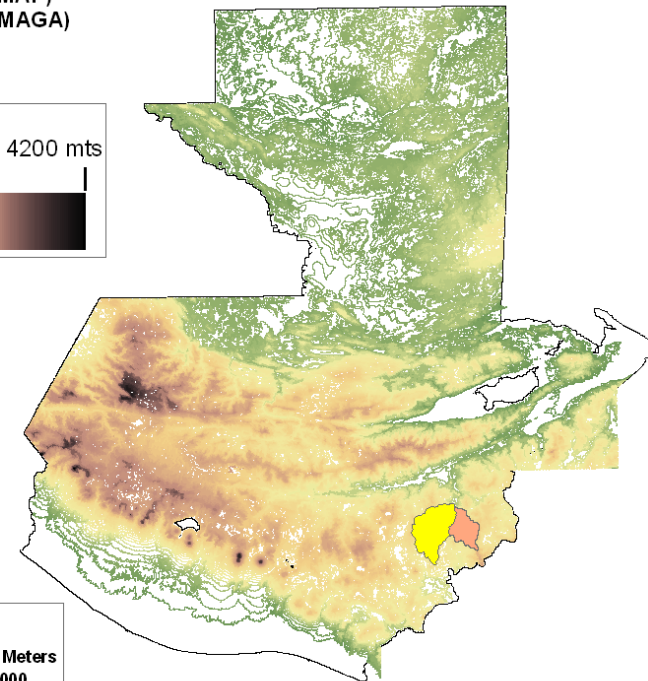
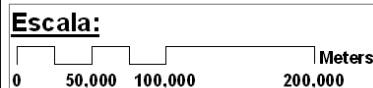
## Ubicacion de Subcuencas San Jose y Shutaque

(hecho con ArcMAP)  
(datos de GIS de MAGA)



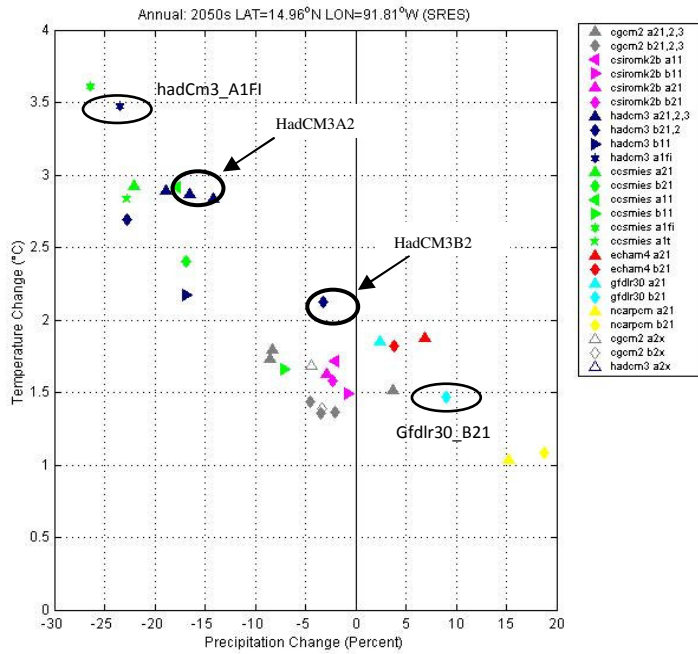
**Subcuencas**

■ Subcuenca San Jose  
■ Subcuenca Shutaque

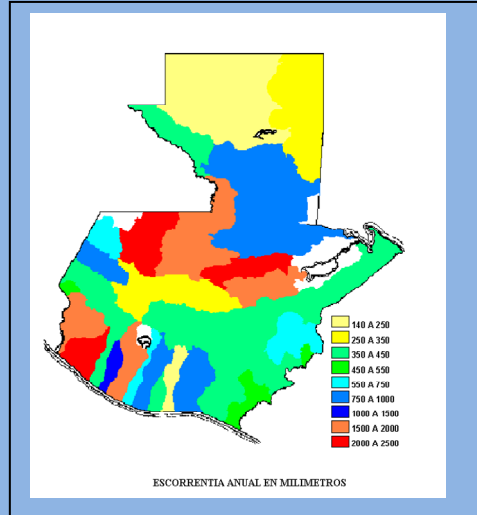


## Sub Water shed Rio San Jose / Shutaque

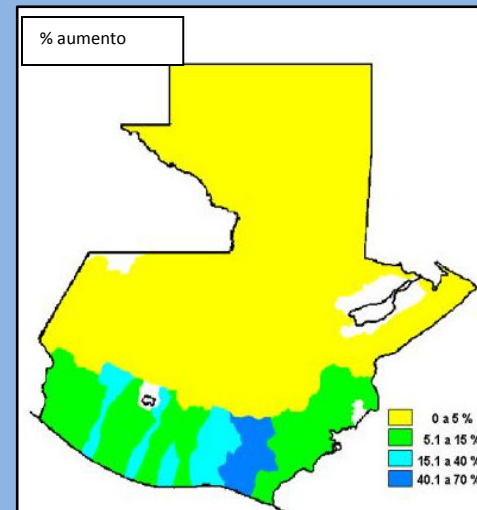
aprox 1100 km<sup>2</sup>  
aprox 64,328 people



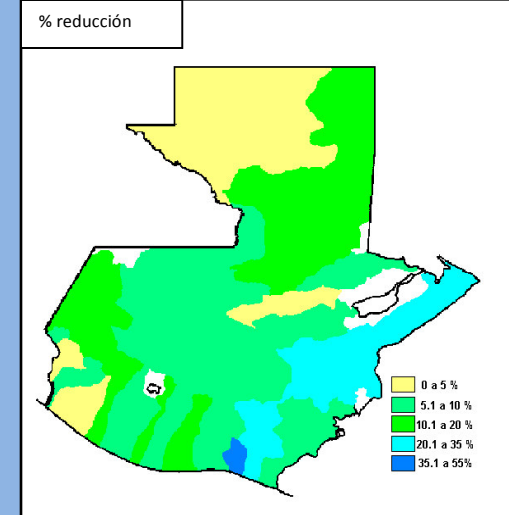
LINEA BASE



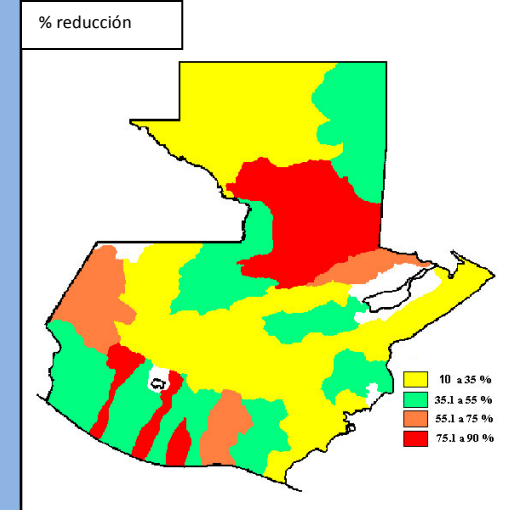
ESCENARIO OPTIMISTA



ESCENARIO NORMAL



ESCENARIO PESIMISTA



# WEAP Model

WEAP is an integrated model of hydrology and planning which has proven to be a very useful tool in the evaluation of vulnerability and measures of adaptation of climatic change with respect to the hydraulic resources.

- Licence for WEAP
  - Go to [www.weap21.org](http://www.weap21.org) and register for a new licence (free for governments, universities and organizations of non profit in developing countries)



# WEAP

It is a software used to help plan integrated hydraulic resources.

The objective is to assist the plan.

It provides table and graphs that are understandable and flexible and easy to use.

Weap was made by the Stockholm Environment , the Boston Institute and by the Tellus Institute.

Weap helps deliver simulations of

- water demand

- run off

- the discharge

- reservoirs

- water treatment

- discharge of contaminants

- water quality

WEB SITE:

[www.weap21.org](http://www.weap21.org)

[www.sei-us.org](http://www.sei-us.org)

# WEAP capacities

- High level local or regional planning
- Demand management
- Water distribution
- Infrastructure evaluation

## Study Definition

Spatial Boundary  
Time Horizon

System Components  
Network Configuration

## Current Accounts

Demand  
Reservoir Characteristics  
River Simulation

Pollutant Generation  
Resources and Supplies  
Wastewater Treatment

## Scenarios

Demographic and Economic Activity  
Patterns of Water Use, Pollution Generation  
Water System Infrastructure  
Hydropower  
Allocation, Pricing and Environmental Policy  
Component Costs  
Hydrology

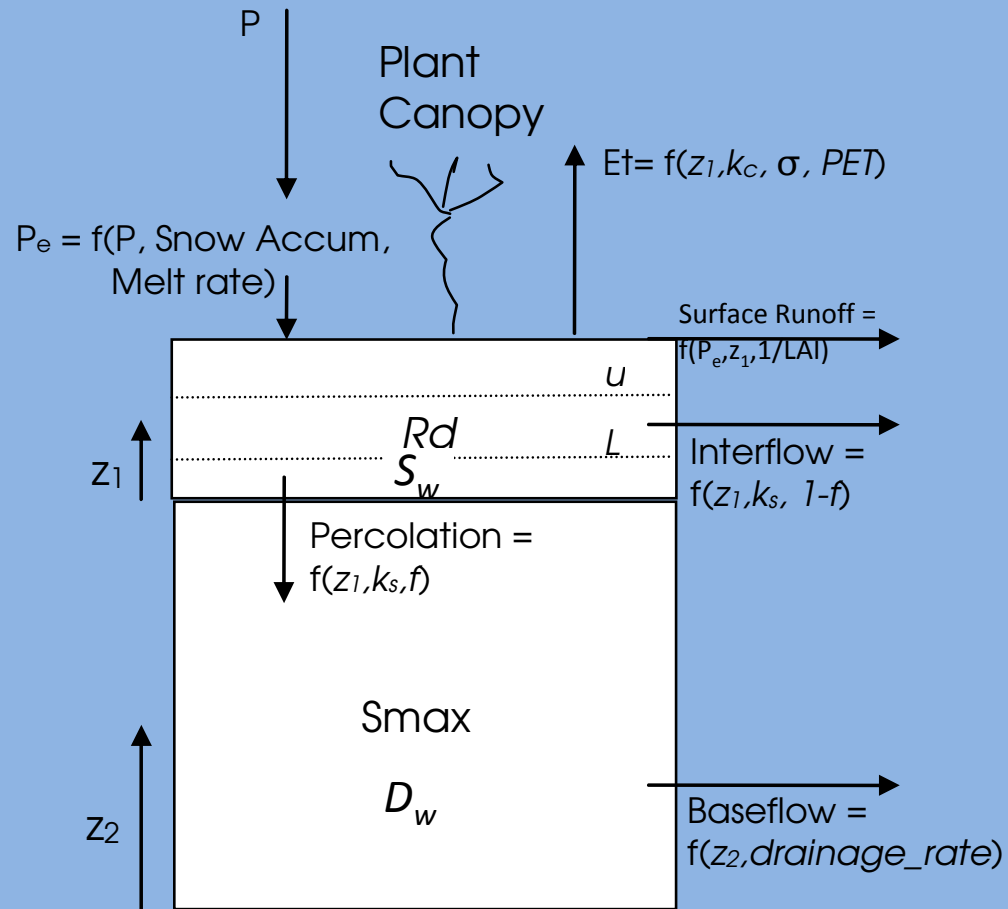
## Evaluation

Water Sufficiency  
Pollutant Loadings

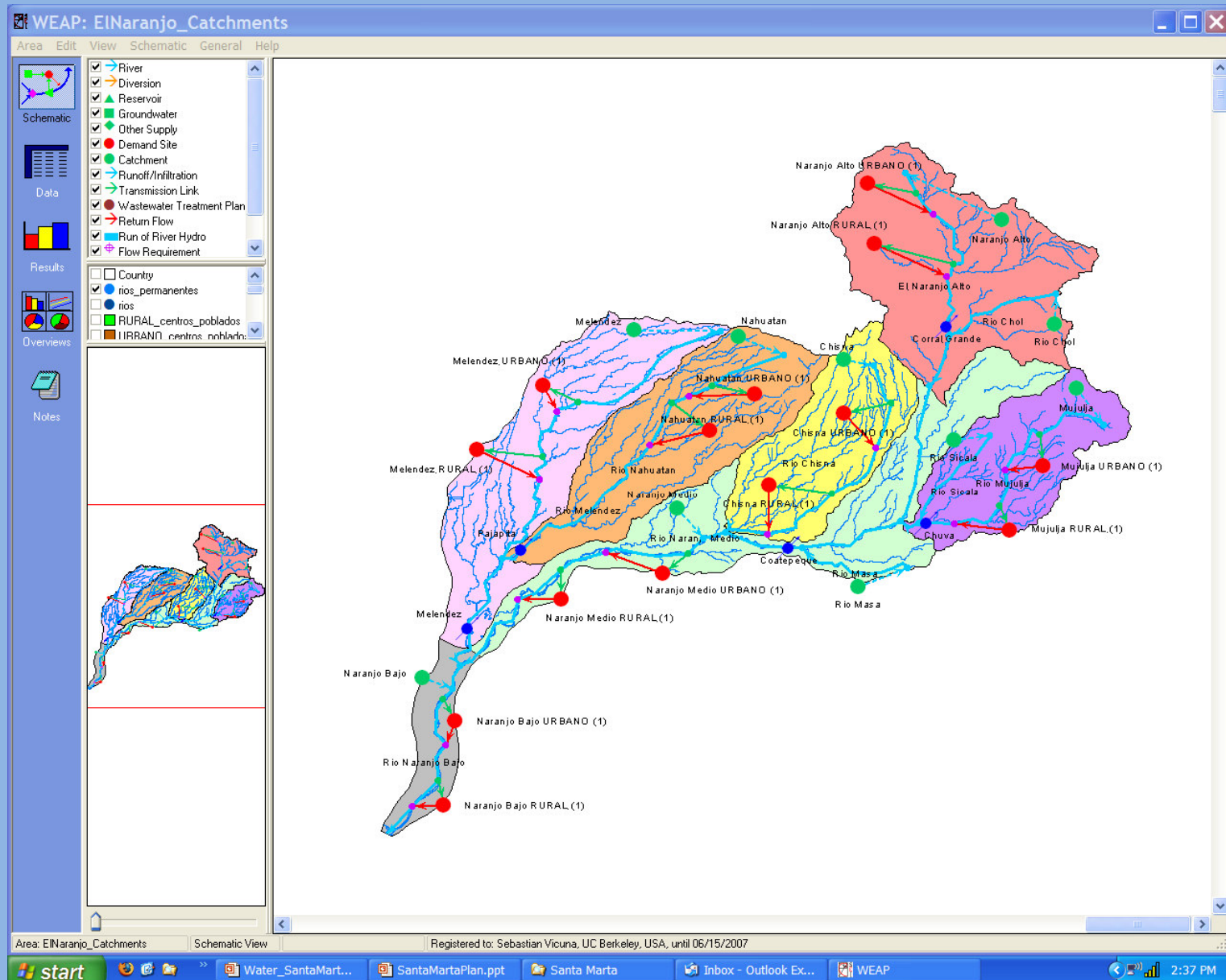
Ecosystem Requirements  
Sensitivity Analysis



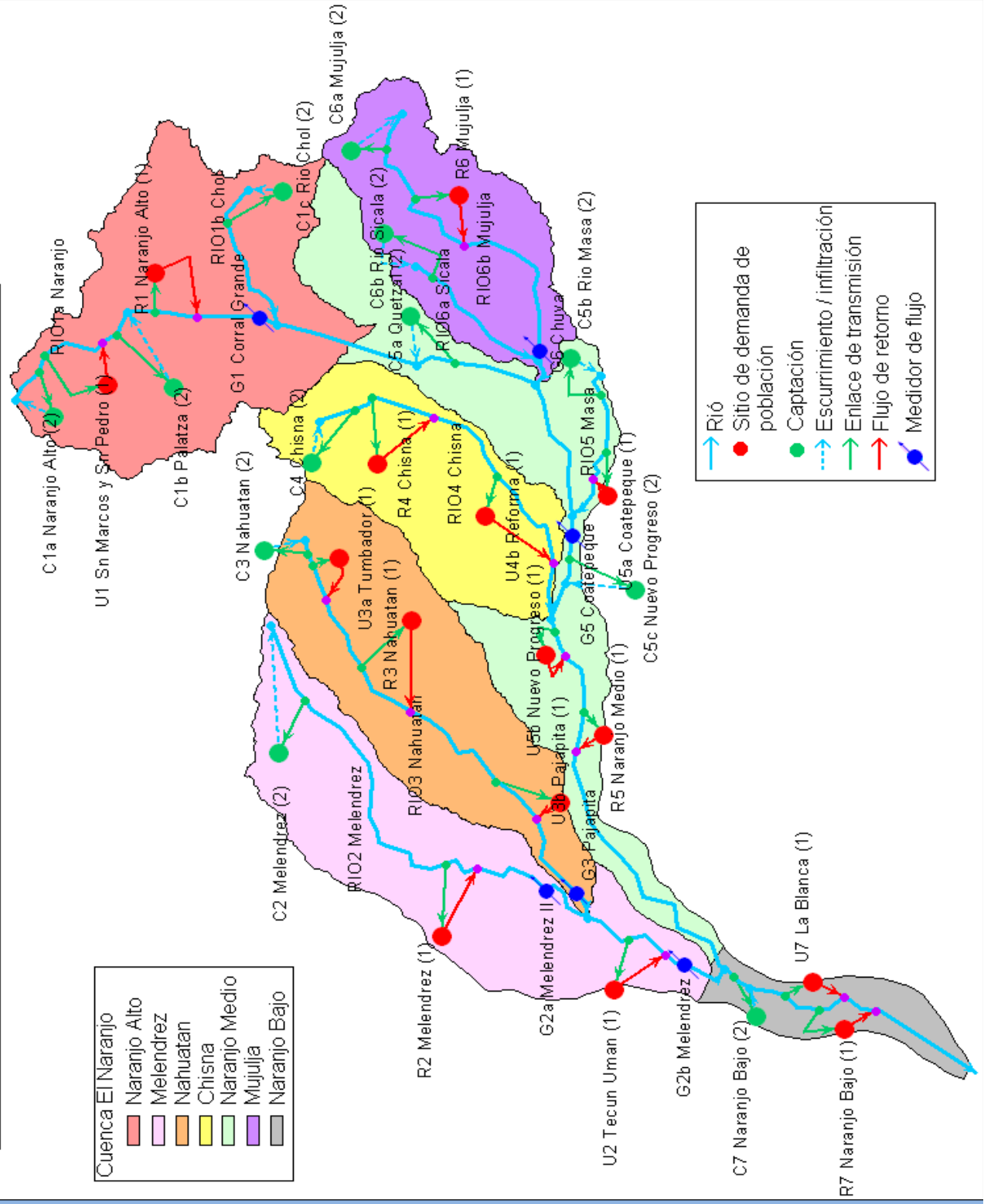
# The hydraulic model 2-Bucket in WEAP



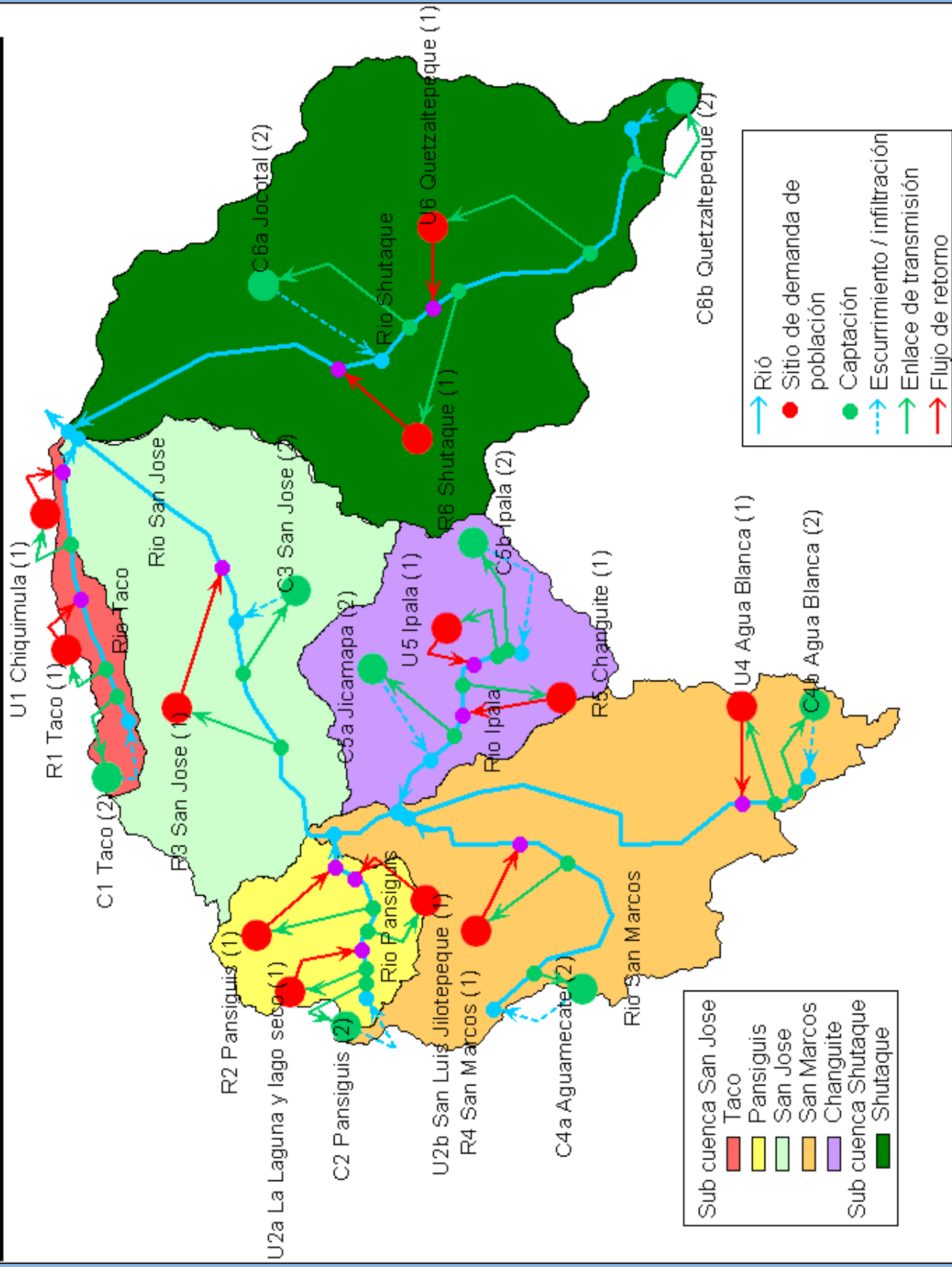
# WEAP: Interface with the user



## Esquema de modelo de Cuenca El Naranjo hecho en WEAP



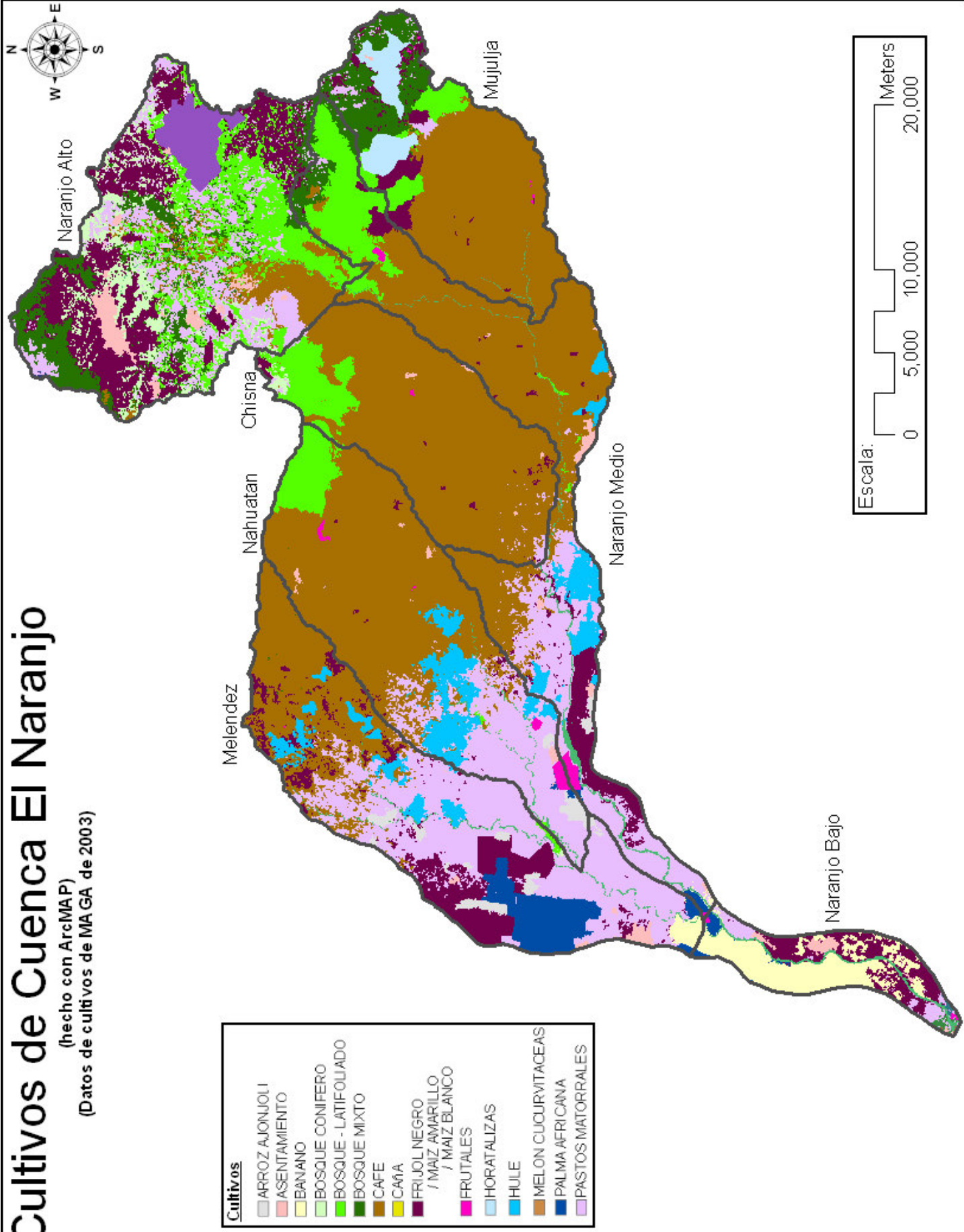
# Esquema de modelo de Subcuenca San Jose y Shutaque hecho en WEAP





# Cultivos de Cuenca El Naranjo

(hecho con ArcMAP)  
(Datos de cultivos de MA GA de 2003)



# Poblaciones de Cuenca El Naranjo

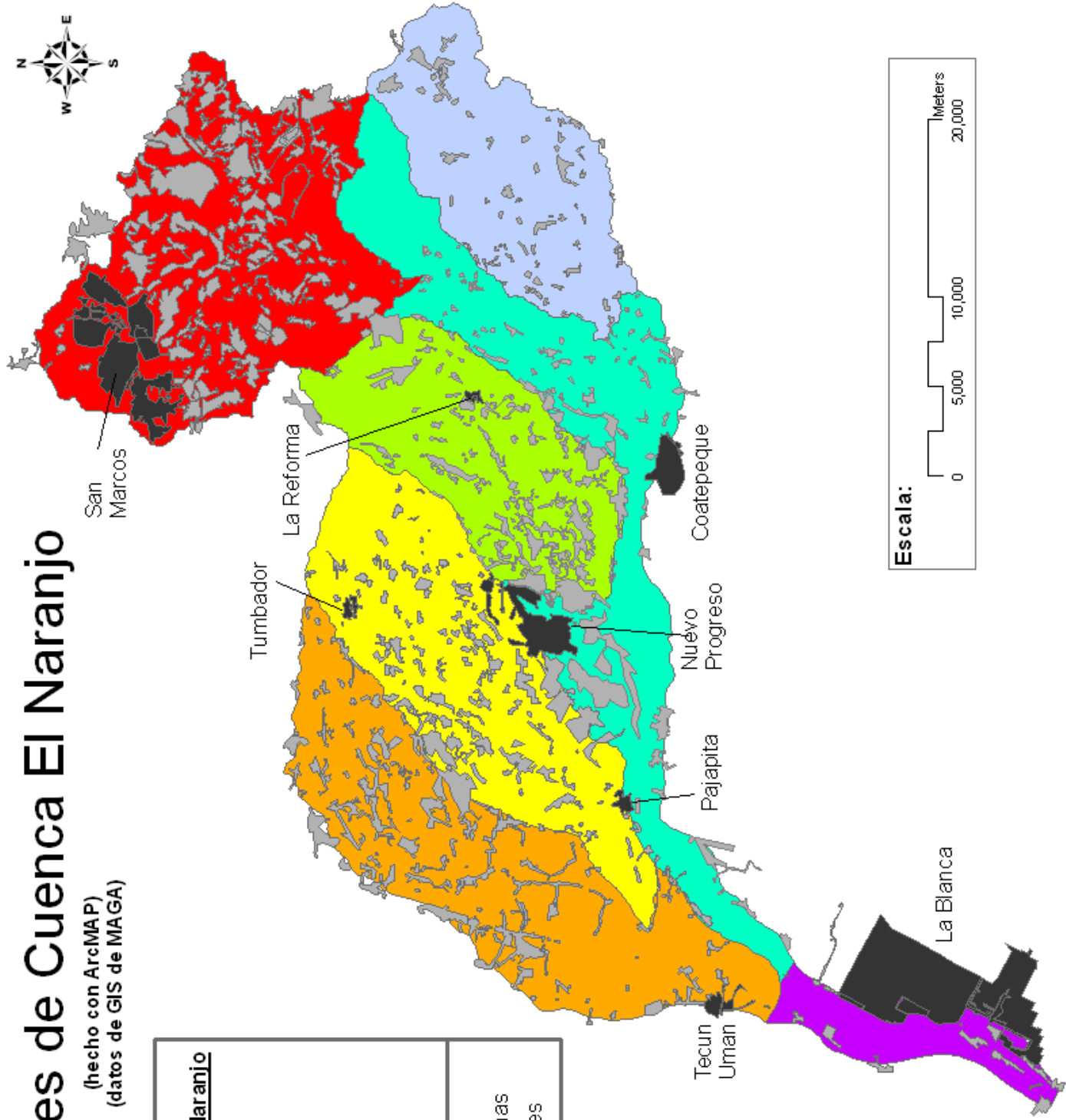
(hecho con ArcMAP)  
(datos de GIS de MAGA)

## Divisiones de Cuenca El Naranjo

- Naranja Bajo
- Mujuja
- Naranja Medio
- Chisna
- Nahuatan
- Melendez
- Naranja Alto

## Poblaciones

- poblaciones urbanas
- poblaciones rurales





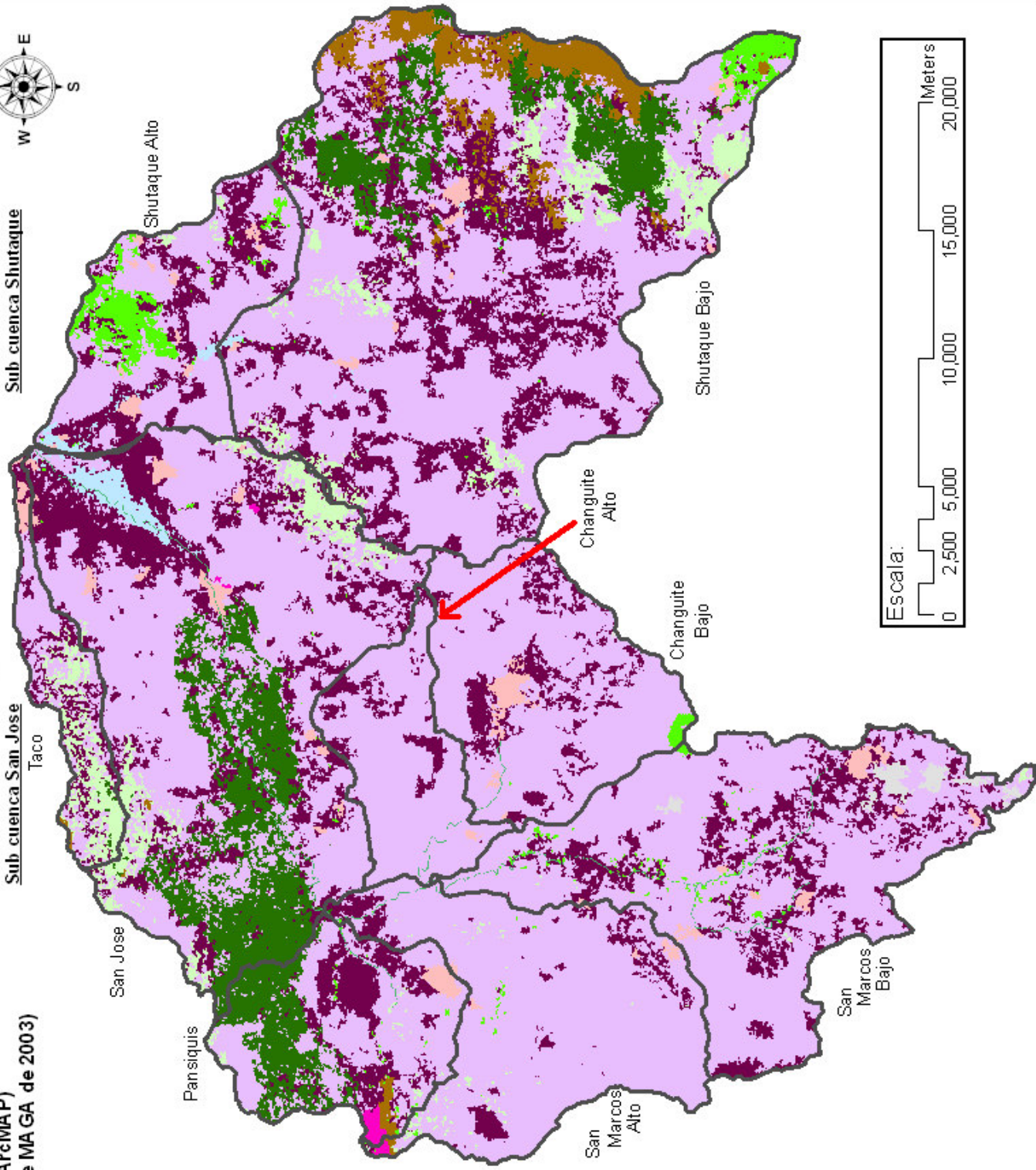
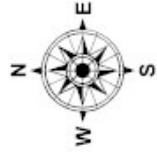
# Sub Cuenca San Jose y Shutaque

(hecho con ArcMAP)  
(Datos de cultivos de MA GA de 2003)

Sub cuenca Shutaque

Sub cuenca San Jose

Taco



Escala:

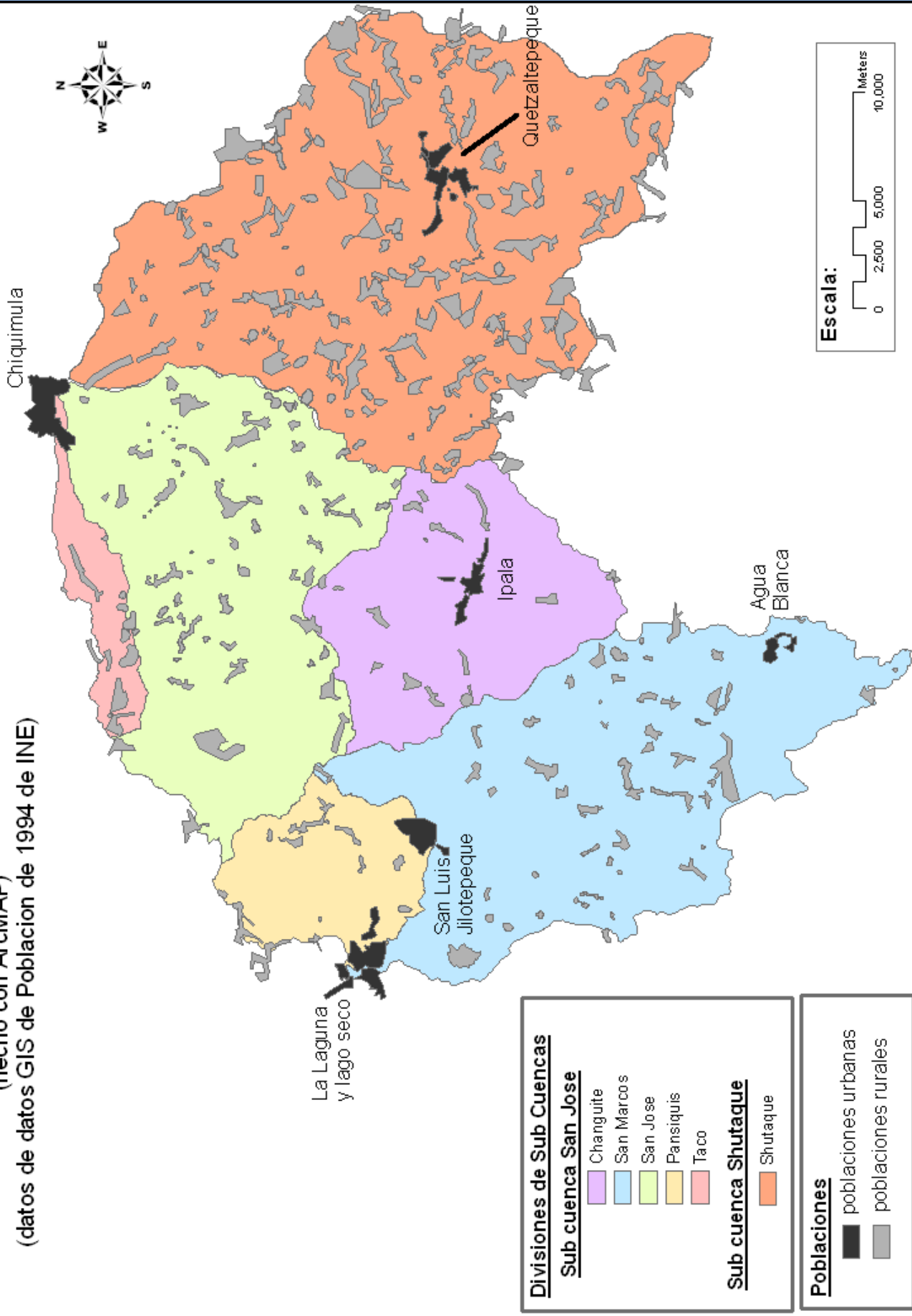


## Cultivos

- ARROZ AJONJOLI
- ASENTAMIENTO
- BANANO
- BOSQUE CONIFERO
- BOSQUE - LATIFOLIADO
- BOSQUE MIXTO
- CAFE
- CAMA
- FRIJOL NEGRO / MAIZ AMARILLO / MAIZ BLANCO
- FRUTALES
- HORATALIZAS
- HULE
- MELON CUCURBITACEAS
- PALMA AFRICANA
- PASTOS MATORRALES

# Poblaciones de Sub Cuenca San Jose y Shutaque

(hecho con ArcMAP)  
(datos de datos GIS de Poblacion de 1994 de INE)





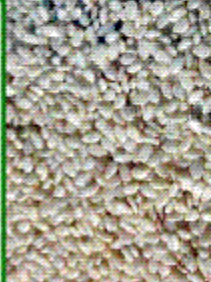
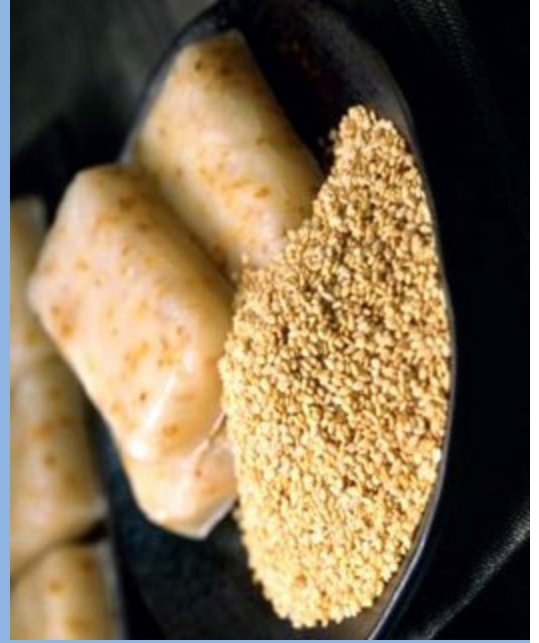
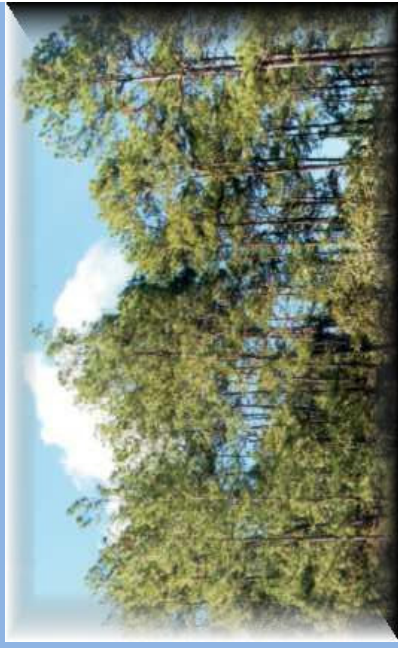


Figura 4.20 Comparación caudales mensuales estaciones seleccionadas en cuenca del río Naranjo

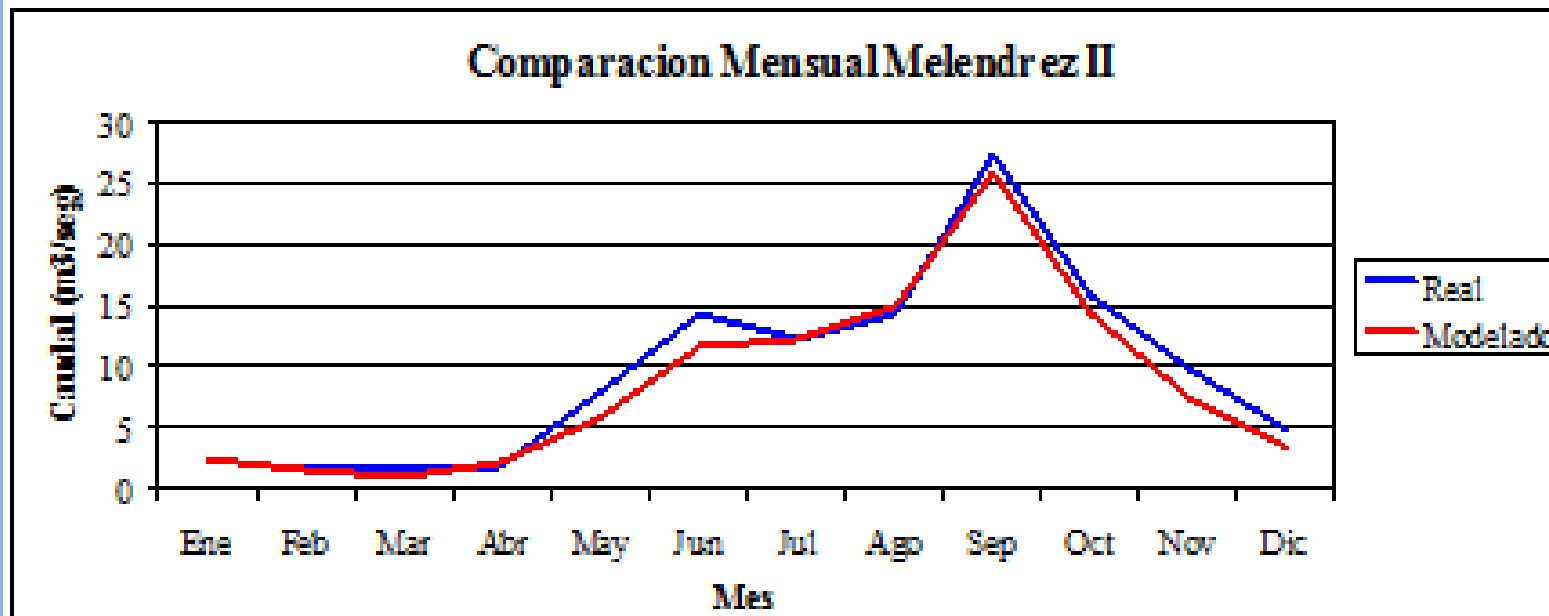
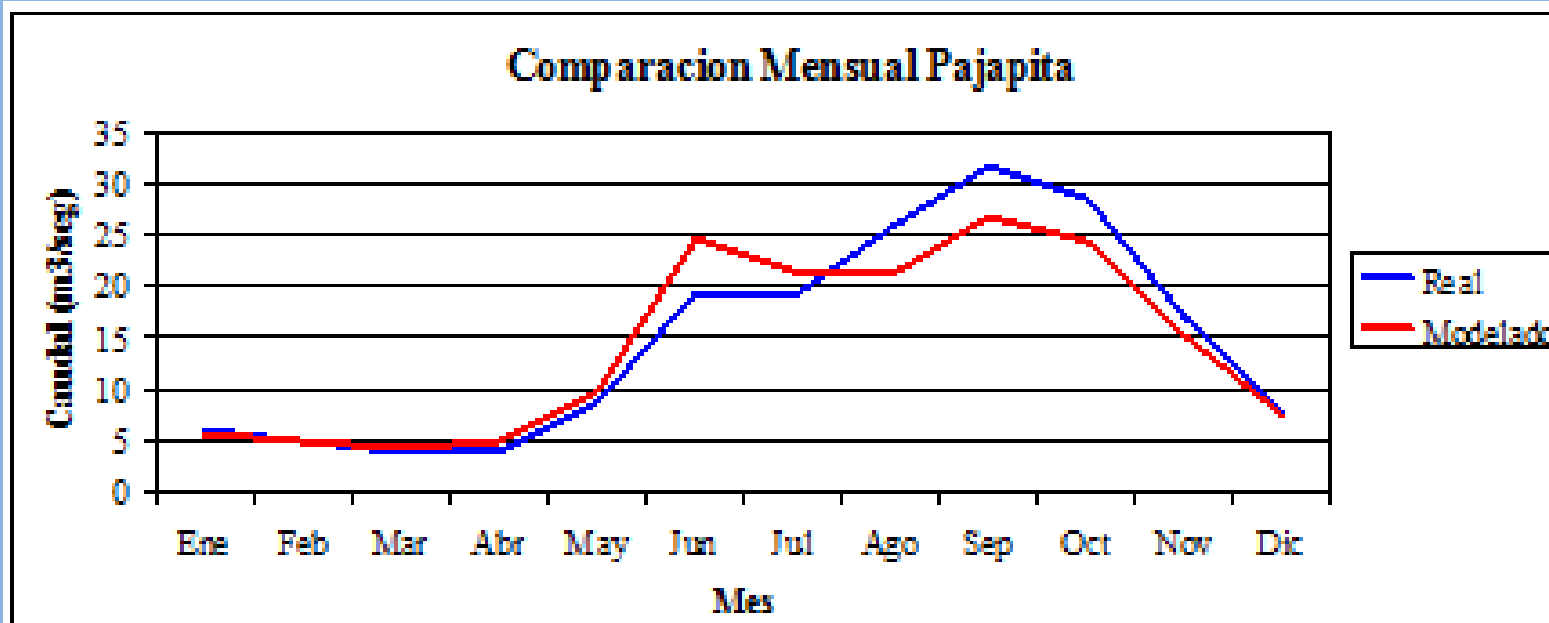


Figura 4.21 Comparación serie de tiempo caudales anuales en cuenca del río Naranjo

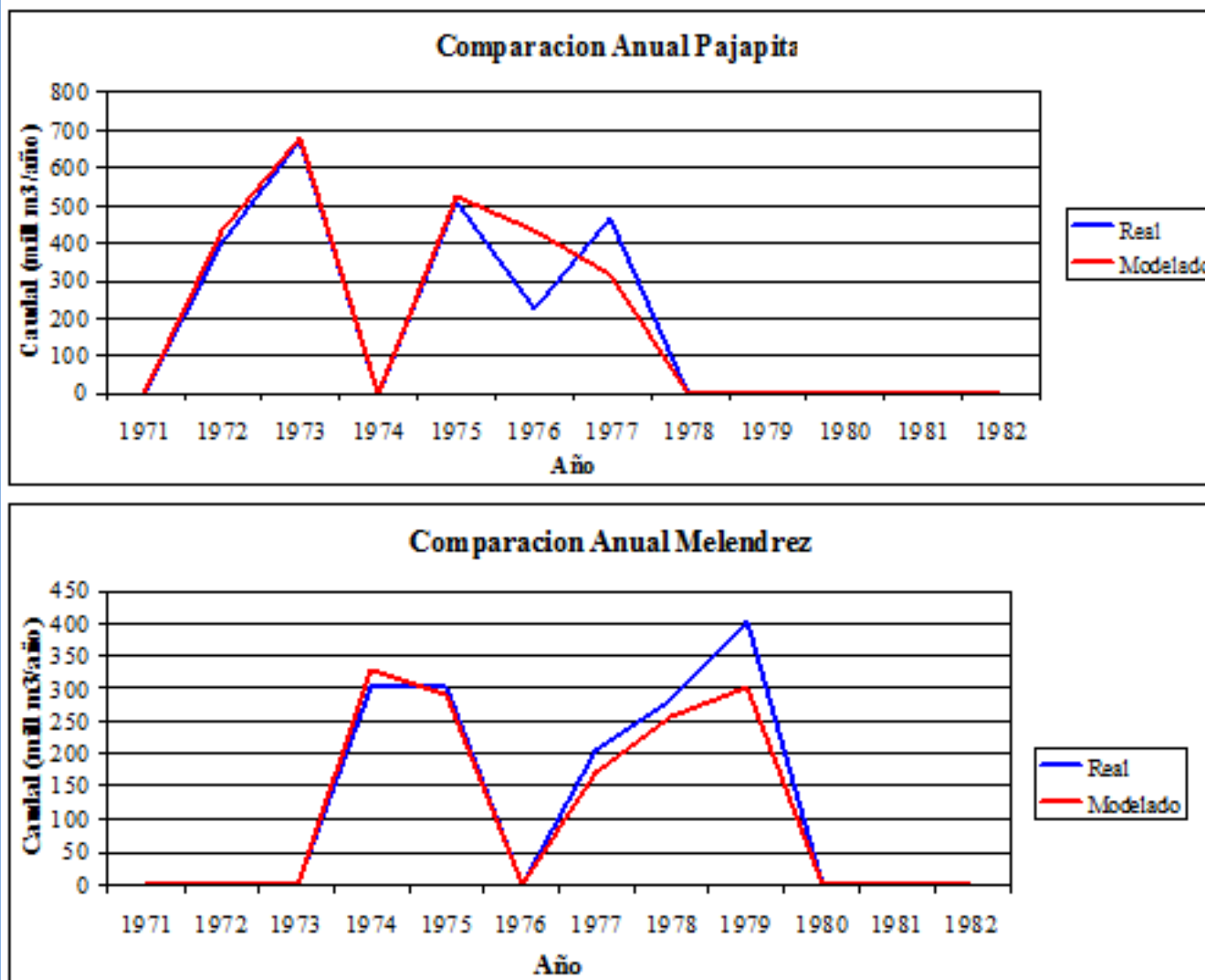


Figura 4.22 Comparación promedio caudales mensuales en subcuencia de los ríos San José/Shutaque

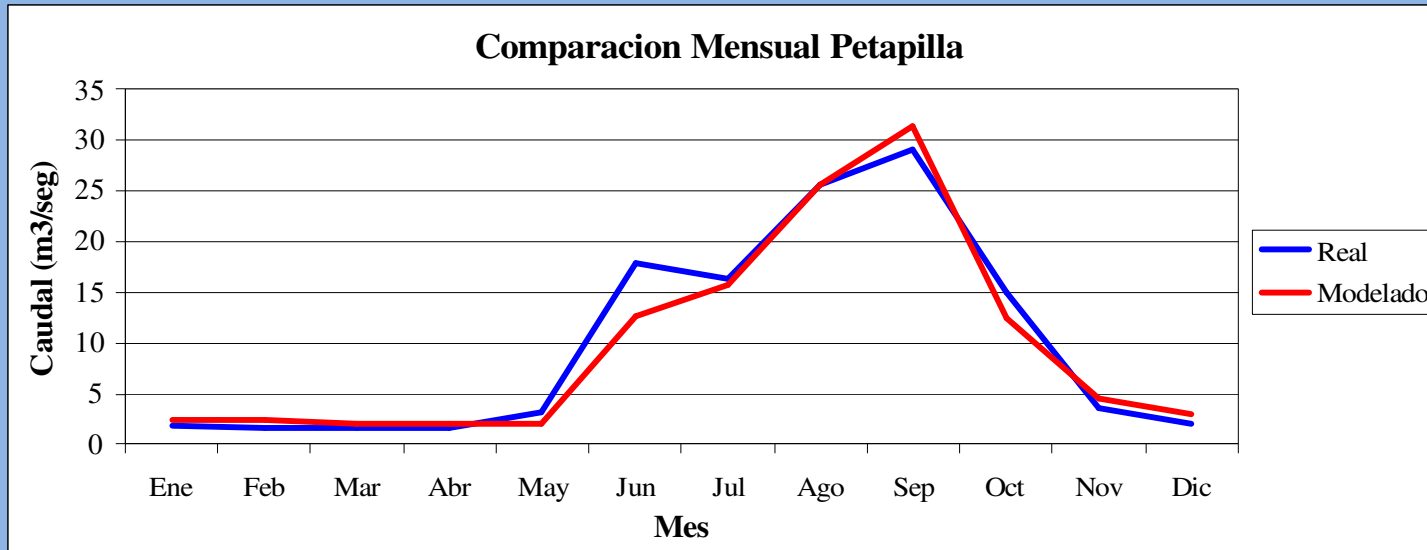


Figura 4.23 Comparación serie de tiempo caudales anuales en subcuencia de los ríos San José/Shutaque

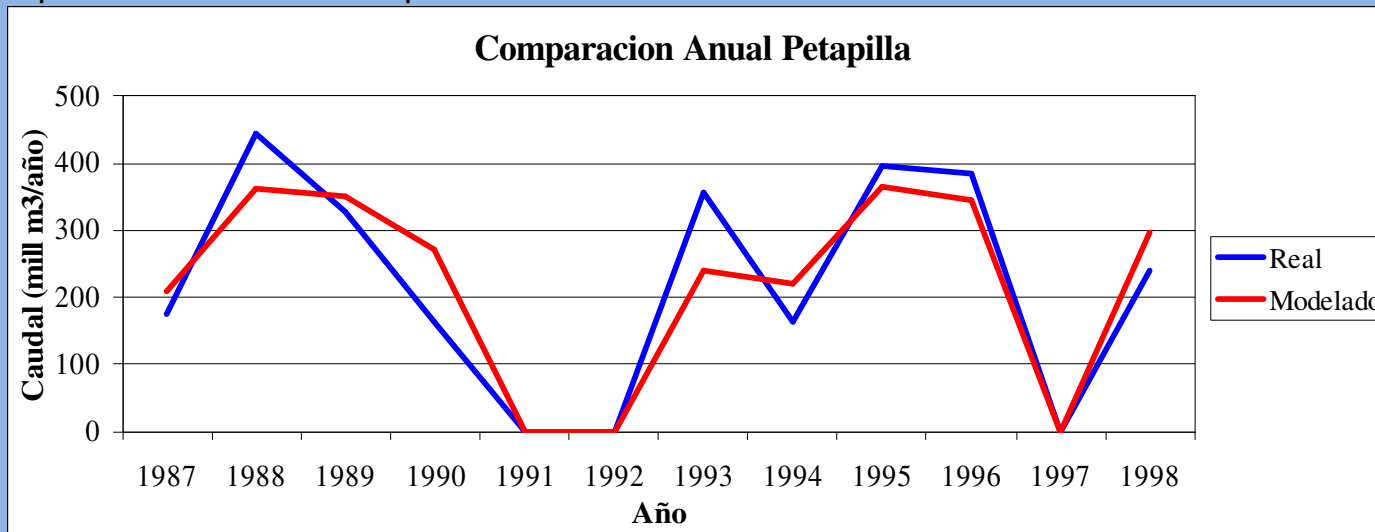




Figura 5.2 Curvas de excedencia caudal máximo diario en Río Naranjo/Coatepeque

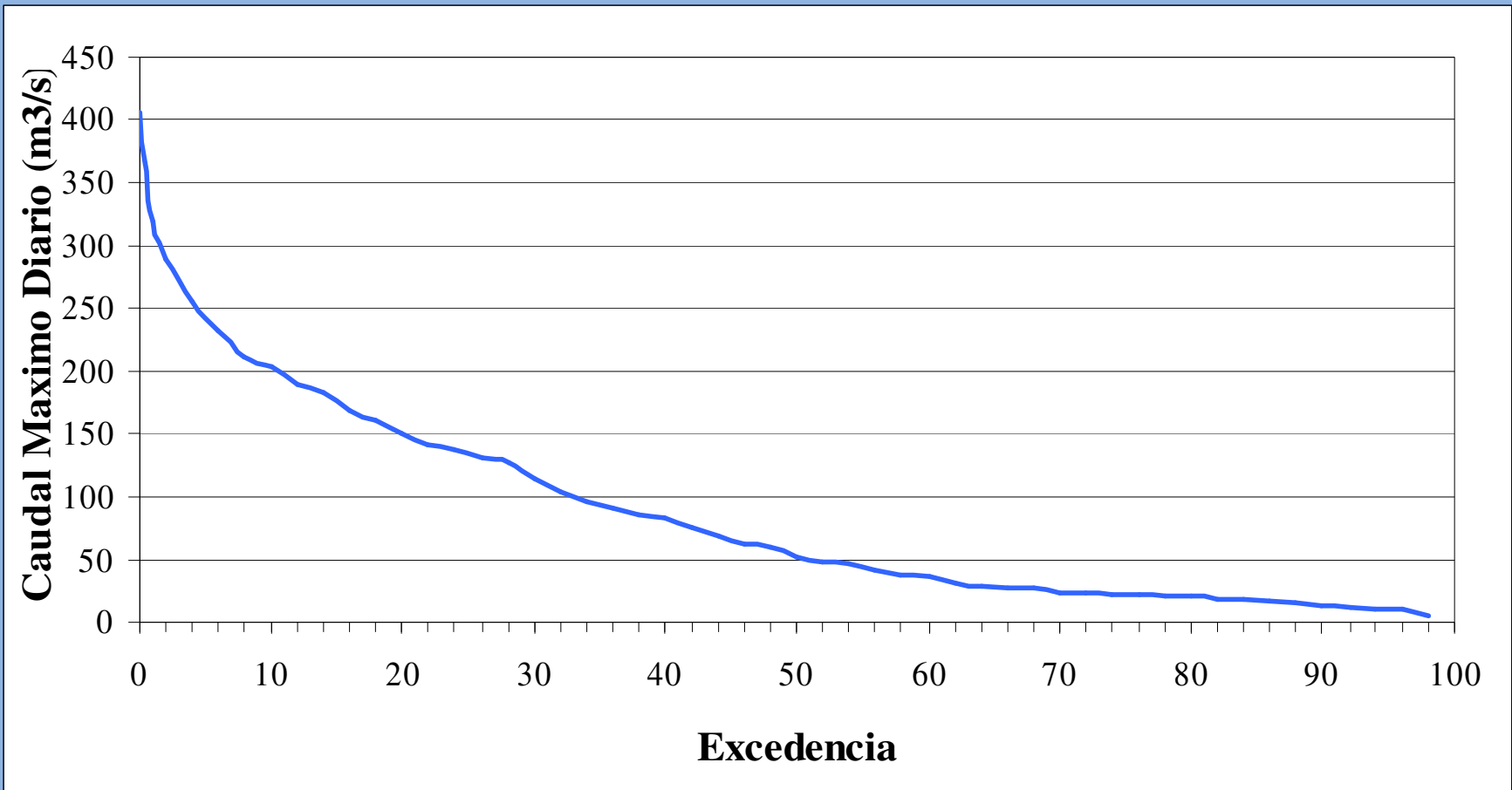
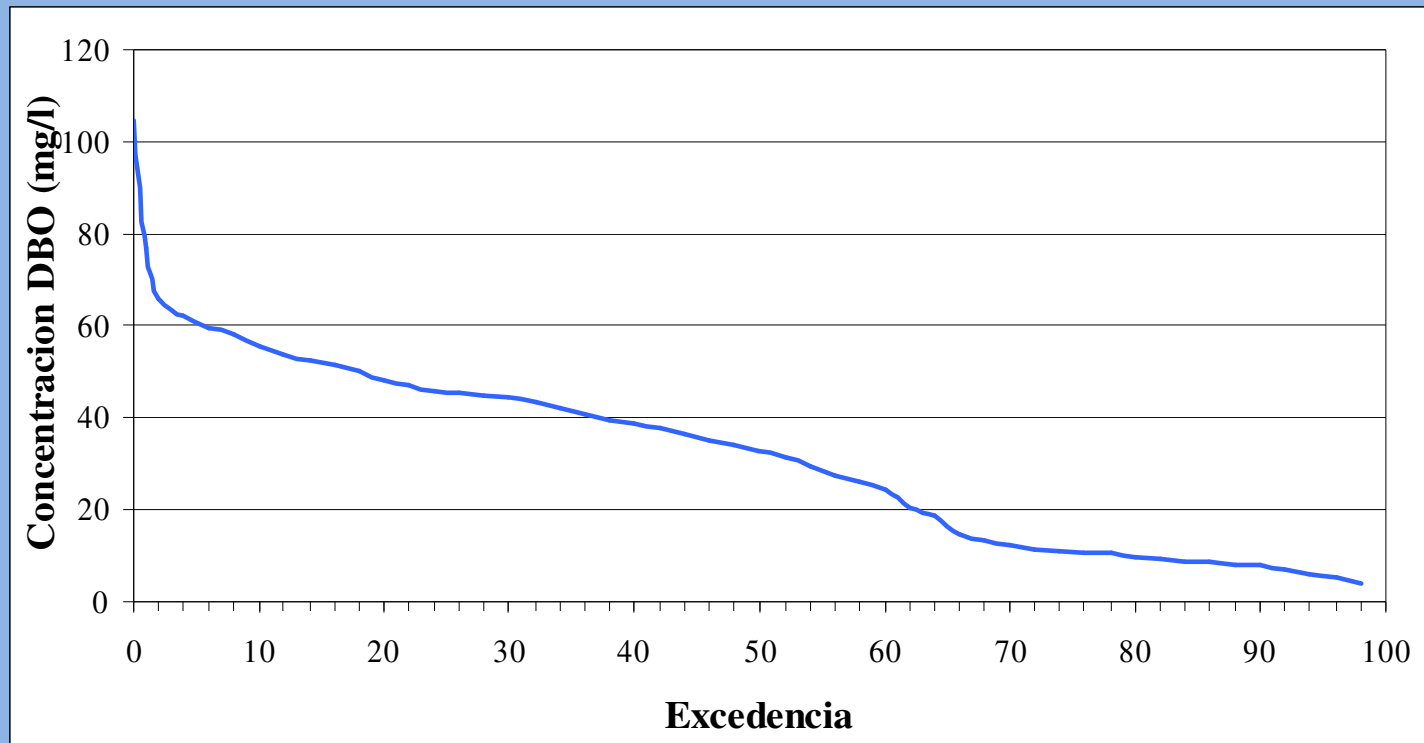
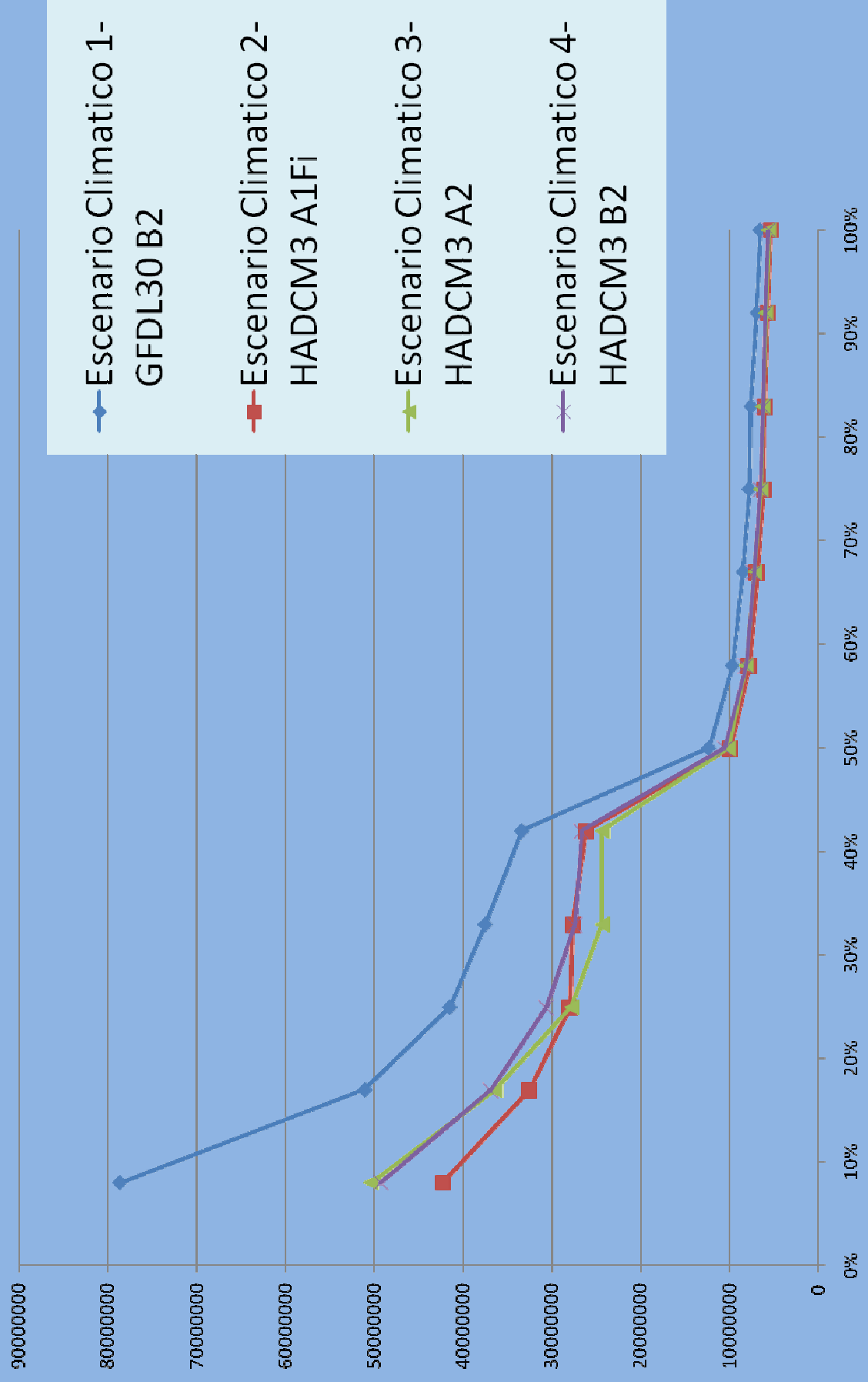


Figura 5.3 Curvas de excedencia concentración DBO en el punto de descarga de San Marcos



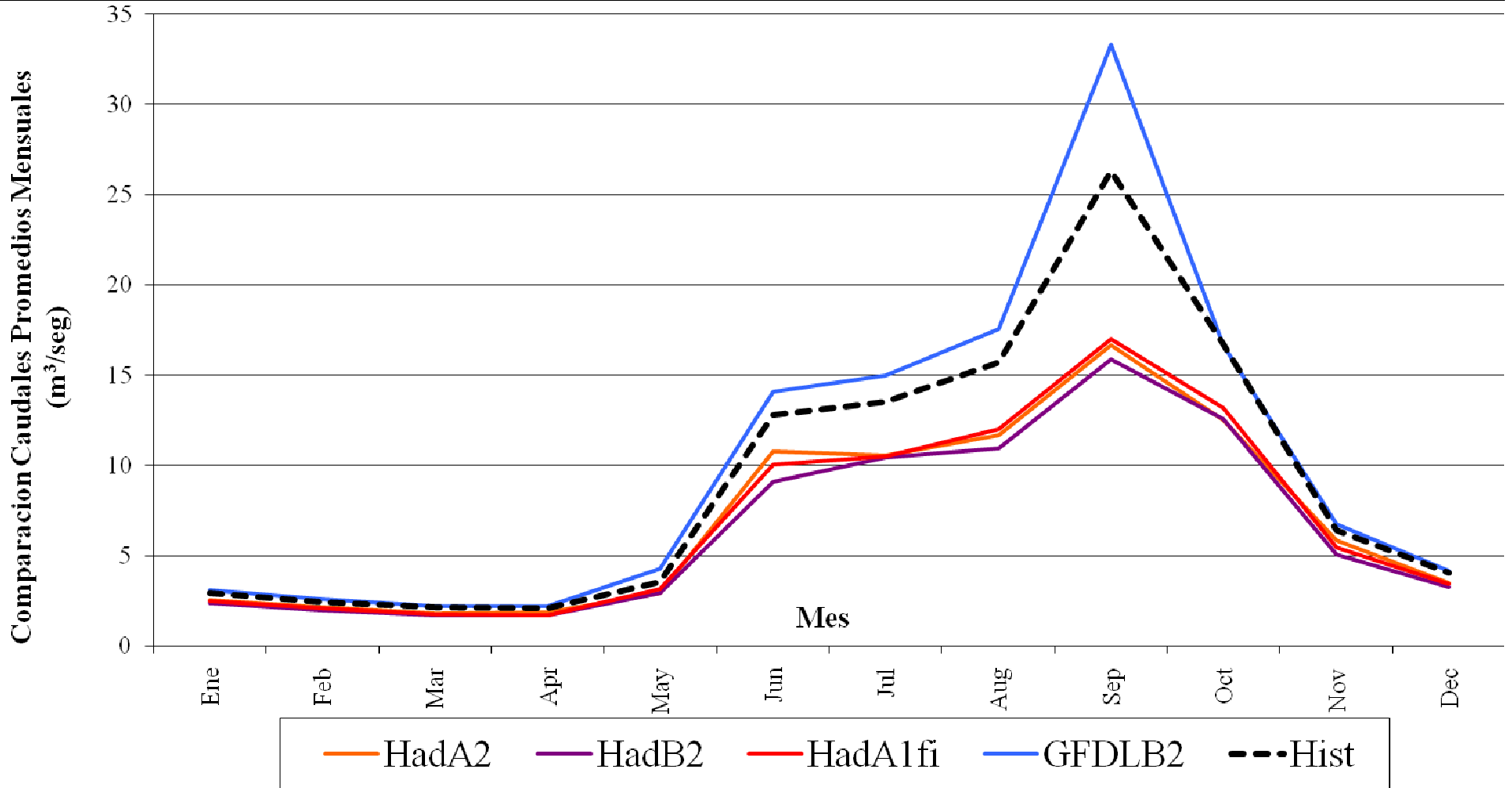
# Conclusions

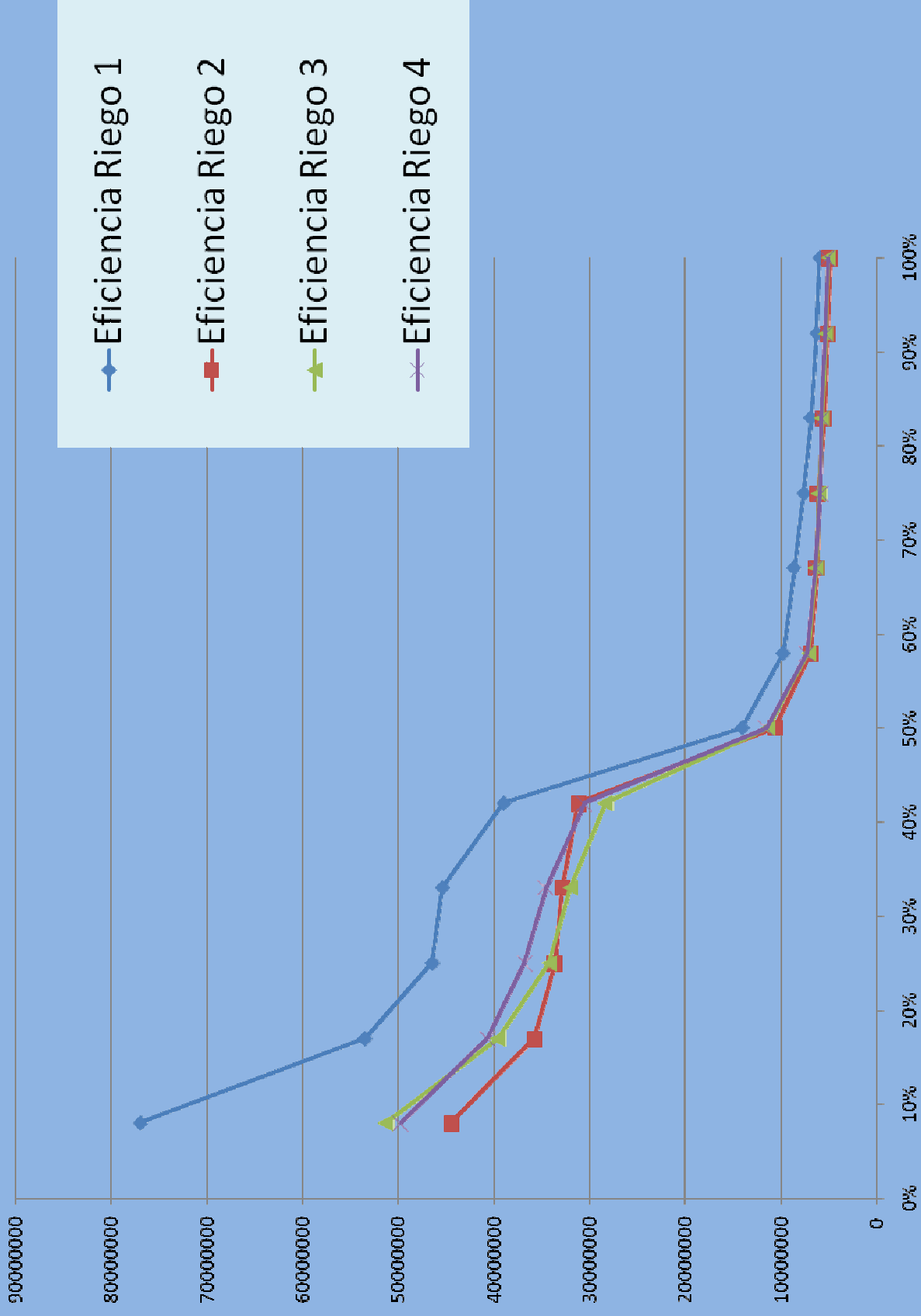
The model created for the water shed El Naranjo and the water shed San José and Shutaque along with the calibration of the model, have had a satisfactory result.

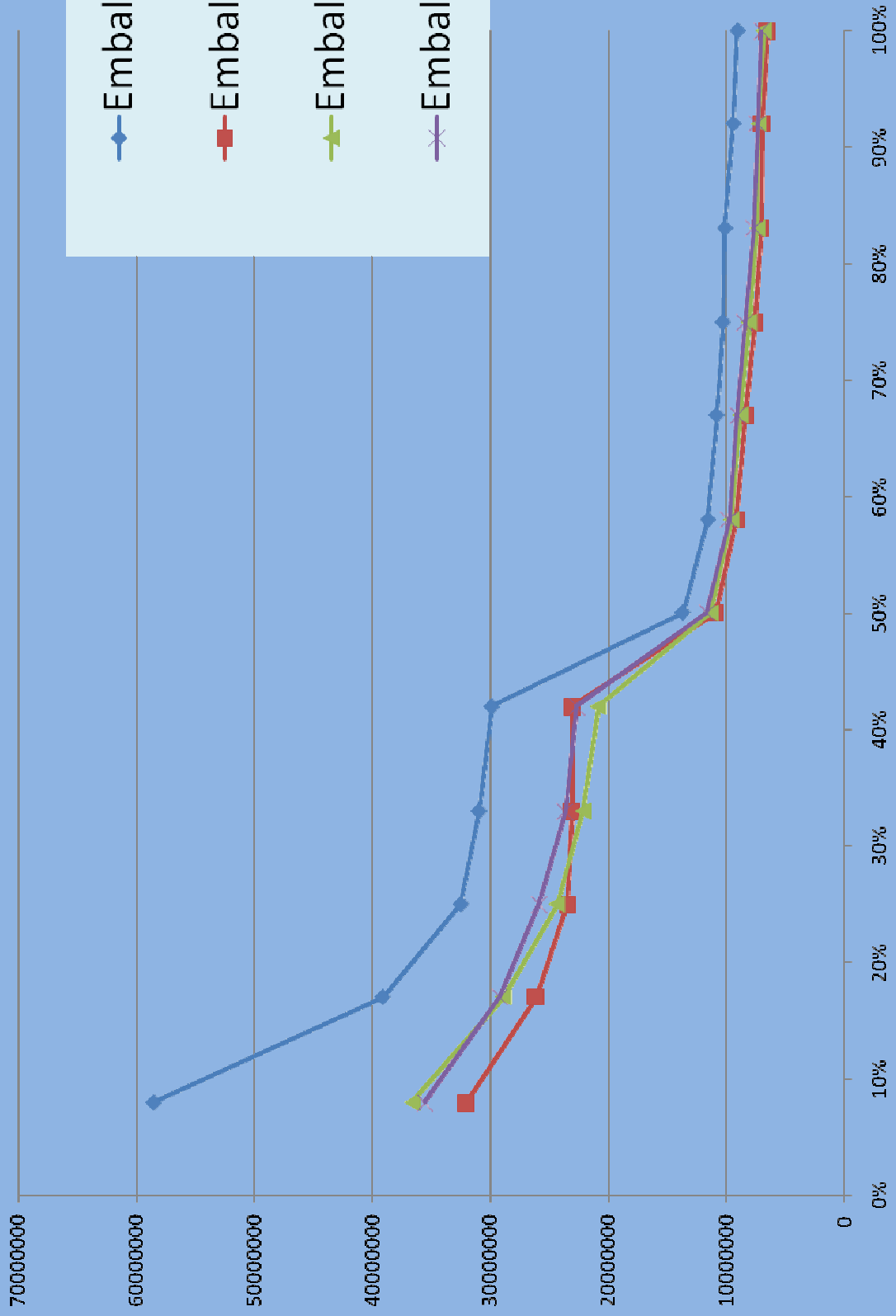




# Comparing average monthly discharges (El Naranjo Sitio 1: Below Return Flow Node 9)







Embalse 1

Embalse 2

Embalse 3

Embalse 4

Monitoring of  
water quality  
(example: BOD)



Workshop in San Marcos with sub water  
shed “El Naranjo” Model



Workshop in Chiquimula with sub water  
shed “San Jose / Shutaque” Model





Bandera de Guatemala



Guatemala

Una de las cosas



Banco Cuscatlan, Zona 10 Guatemala



Muelle Champenico

Guatemala una de las cosas





# Thank you!

Jeffrey Rivera ([admin@constructingdreams.net](mailto:admin@constructingdreams.net))