



The Economics of Ecosystems & Biodiversity



This project is funded
by the European Union



Ministerio
del **Ambiente**

Integrating the Value of Ecosystem Services in the Cocoa Value Chain: the case of the Daule-Vinces Irrigation project in the Guayas River Basin, Ecuador.



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A TEEB CASE STUDY IN ECUADOR



- Besides Petroleum, still agriculture is the most **important socio-economic activity in Ecuador**, and in the Guayas River Basin.
- **Agriculture** is arguably the **highest policy priority** on today's global political agenda.
- **Widespread impacts** on food security, employment, climate change, human health, and severe environmental degradation.



1. **IMPACT ORIENTED ECOSYSTEM SERVICES VALUATION (POLICY)**
2. **FROM BIOPHYSICAL MODELING TO ECONOMIC VALUATION MODELING**
3. **RESULTS BASED ON VALUATION SCENARIOS**
4. **A COMMUNICATION STRATEGY FOR EFFECTIVE OUTREACH**



IMPACT ORIENTED ECOSYSTEM SERVICE VALUATION

Based on consultations and effective collaboration

Case identification



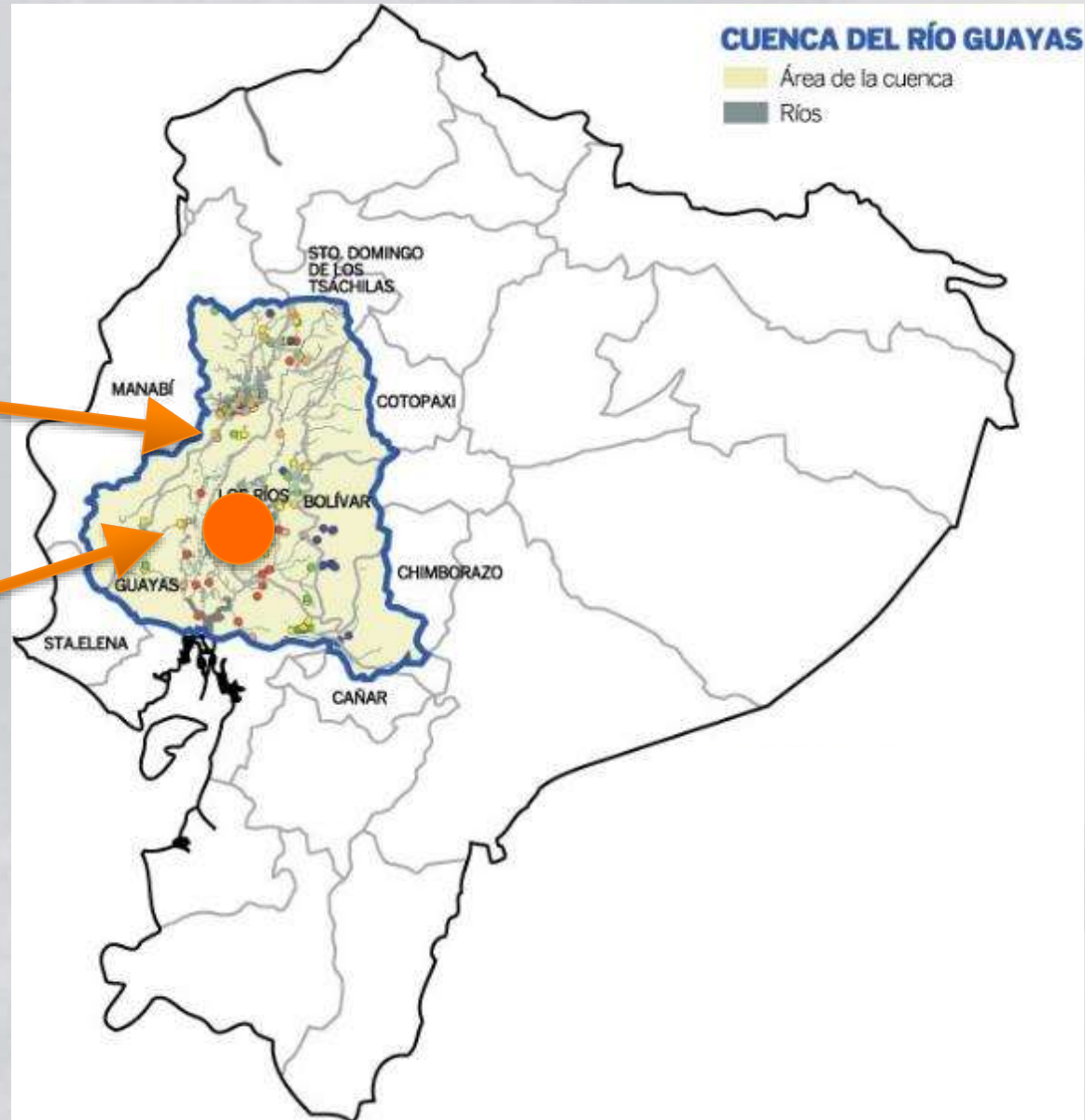
- Important investments in Ecuador for developing multipurpose hydraulic infrastructures.
- One of the projects is the **Daule-Vinces (or DAUVIN) Water Transfer Project**, which is located in the **Guayas River Basin**, the most important area for agriculture in Ecuador.

Case identification



- Irrigation capacity: 100.000 ha.
 - Beneficiaries: 120.000 people.
 - Majority are small land holders.
- No clear definition about **what type of agriculture and what type of development model can be more adequate for the area.**

Ecuador - Guayas River Basin



Guayas River Basin

Daule-Vinces Water Transfer System

The Ecuadorian Cocoa

- **Ecuador** is one of the **leading** countries in **cocoa production and exports**.
- About 8% of world cocoa production is “Cacao Fino de Aroma” (Fine Cocoa Aroma).
- 80% of this cocoa is produced in LA.
- **Ecuador** alone **produces** about **70% of this cocoa**.
- About **90% are small farmer**.
- About **60% is produced in the Guayas River Basin**, and because of the new irrigation project, it is expected to increase.



Current situation



- **Ministry of Agriculture** started to **promote Cocoa** production in the area of the Dauvin Irrigation Project.
- **International firms** (American and European) started to **invest in the area** (collecting and processing facilities).
- Among **farmers**, there is an **increasing interest in cocoa**, based on its profitability.
- **Excellent future** perspectives in the international market.
- **Local consumption** also started to **increase** as never before.
- High concern on **quality issues** of cocoa associated to presence of **heavy metals** (Cadmium, Mercury, etc).

High Levels Of Heavy Companies say heavy r

ConsumerLab, Natural News Labs both confirm high levels of toxic cadmium in popular cacao powders



Thursday, June 12, 2014
by Mike Adams, the Health Ranger
Tags: cacao powder, cadmium, lab testing results

Facebook (5,953) Twitter Google+ +

Cacao Powders: Lead and Cadmium Lab Results

NaturalNews.com



BY JULIE FIDLER
POSTED ON APRIL 11, 2018



Collaborations from...



Ministerio
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Secretaría Nacional
del **Agua**

Farmer's participation





FROM BIOPHYSICAL TO ECONOMIC MODELING

Based on a multidisciplinary approach 



Cocoa production in the Dauvin



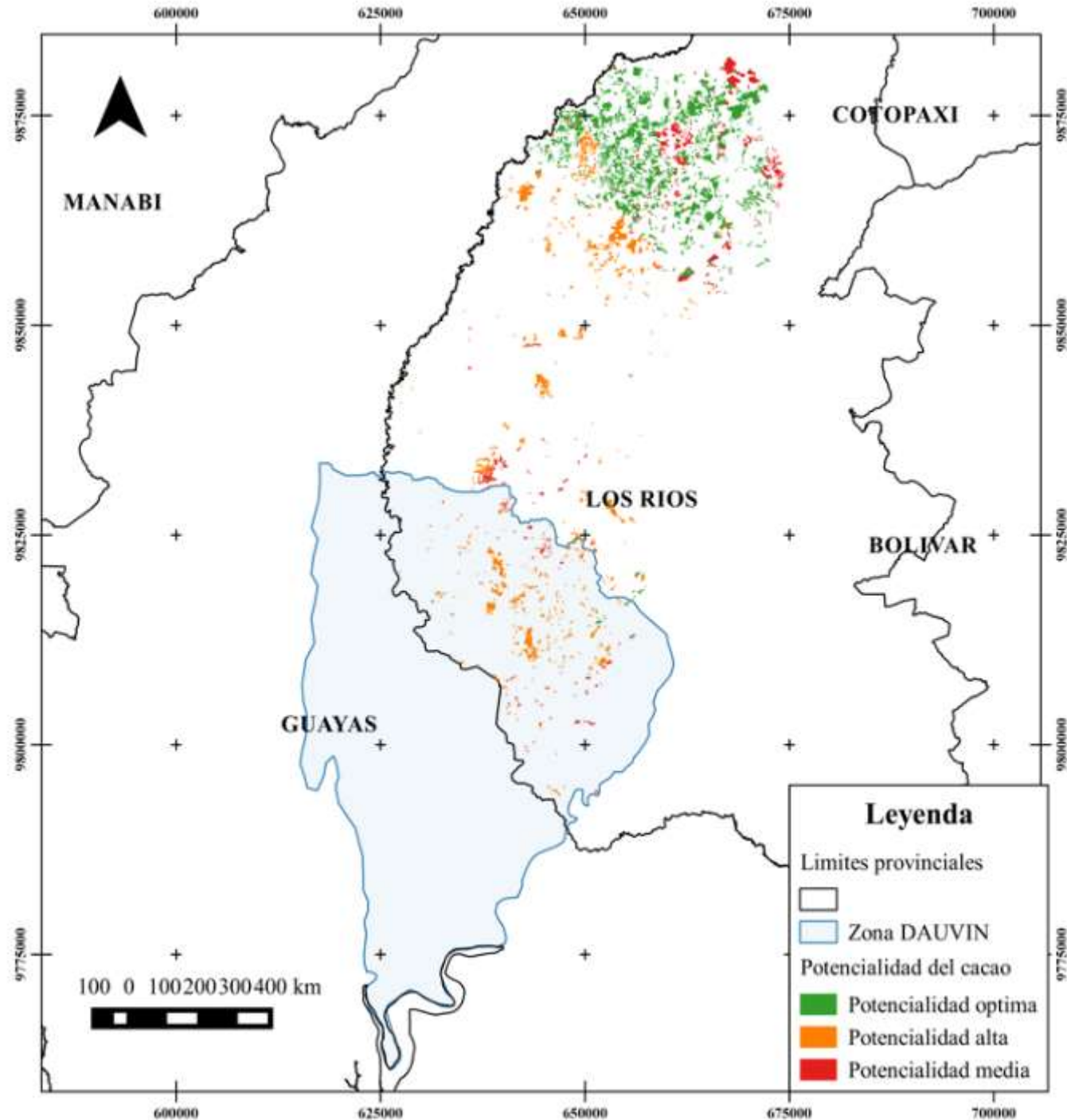
- Are there enough **agro-ecological conditions for cocoa cultivation** in the Dauvin irrigation project?
- Using a soil map (scaled 1-25.000) provided by MAGAP, a two-step cluster analysis based on 14 different variables was performed, to identify the real potential for cocoa cultivation in the area of the study.



Categories:

1. Optimal
2. High
3. Medium
4. Low (not shown)

About 13.000 has.



The Biophysical-Economic model

AGRICULTURAL PRACTICES

IMPACTS

CONSEQUENCES



The Biophysical-Economic model

Agricultural Practices in Cocoa production

- Which affect soils
- Which affect water
- Which affect the plant and the quality of the cocoa beans

Ecosystem services affected

- Soil fertility
- Water quantity and quality

Economic consequences

- Low crop yield
- Limited access to markets and low prices
- Low farmers income
- Poor living conditions

Biophysical model based on...

ANALYSIS OF CERTAIN BIOPHYSICAL KEY PARAMETERS

Elements in soil:

- Nitrogen (total)
- Phosphor
- pH
- Organic matter
- Texture and humidity
- Heavy metals: Cadmium, lead
- Microorganisms in soil and total

Elements in water:

- Nitrogen (total)
- Phosphor
- pH
- Electric conductivity
- Heavy metals: Cadmium, lead

Elements in the cocoa tree leafs:

- Cadmium, lead



150 samples were collected in cocoa farms and analyzed in ESPOL labs. Results are being reviewed and processed.

Economic model based on...

A survey campaign based on a:

- Sampling plan that includes the 150 initial sampled points, plus 350 points inside and outside the Dauvin irrigation project area (Organic producers as control).
- Format included questions about agricultural practices, farm structure and assets, economic aspects of cocoa production, as well as some idiosyncratic variables.

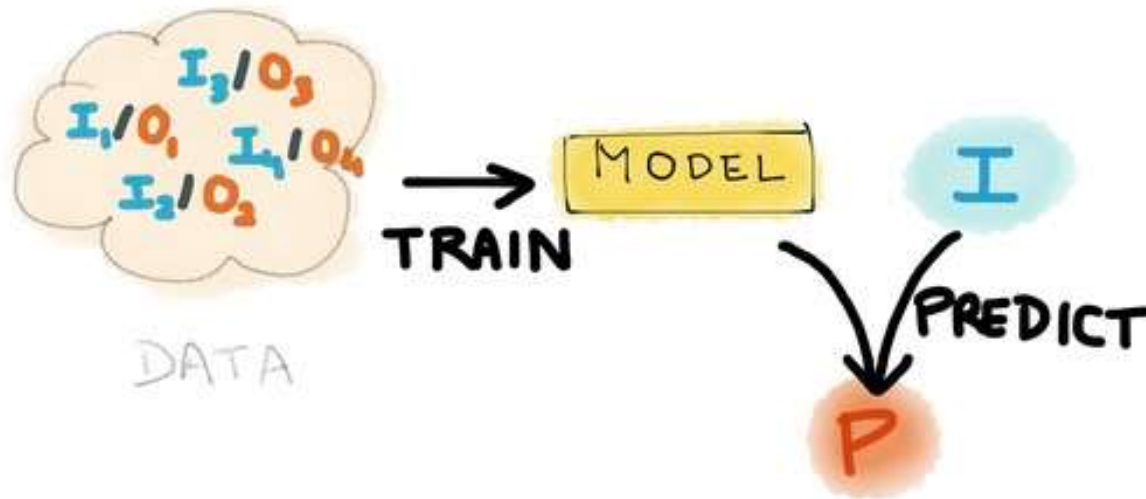


510
questionnaires
were completed
and are being
analyzed by
experts in
statistics and
economic
valuation

Integration of biophysical and economic data

Use of modern data-analysis techniques:

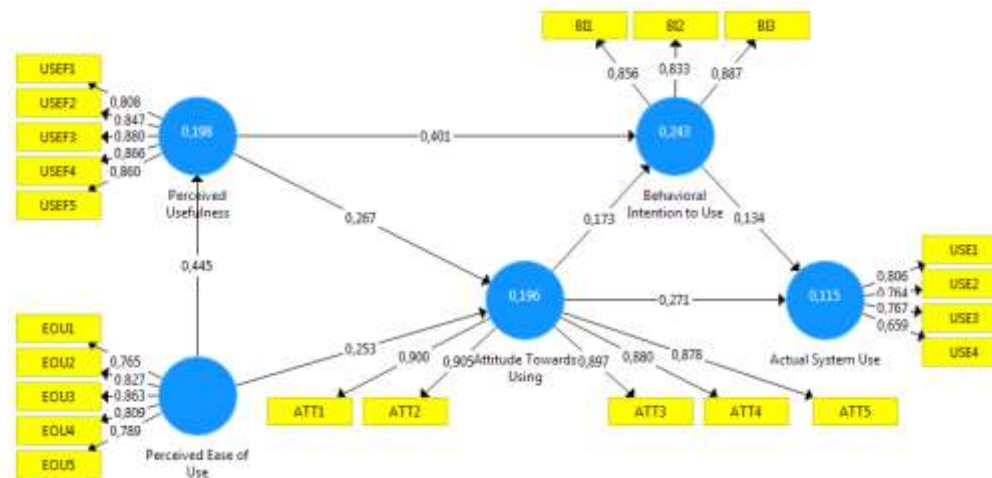
- ✓ Machine learning algorithms.
 - Pattern recognition in order to match the 150 soil, water and plant samples with the 510 surveys



Integration of biophysical and economic data

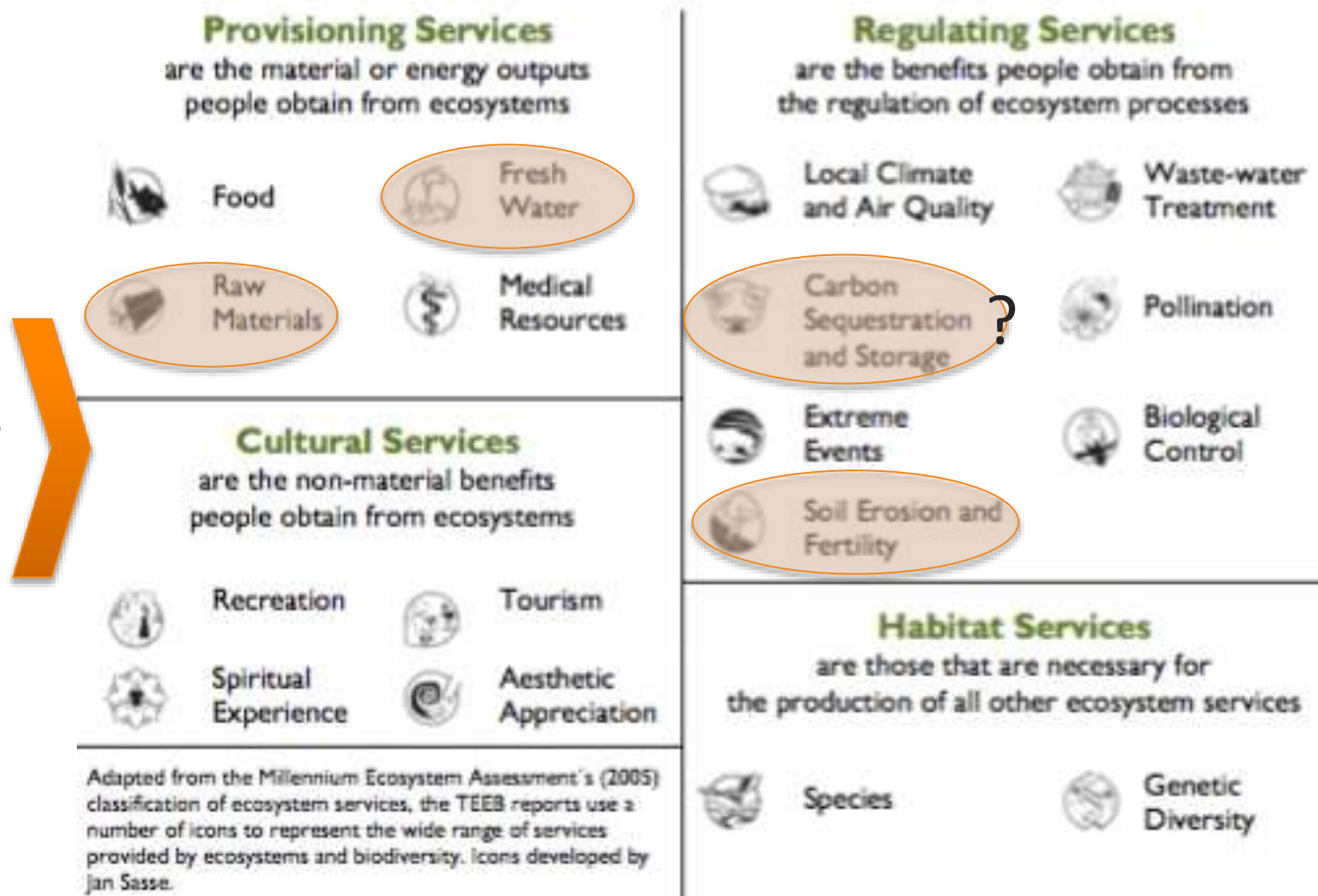
Use of modern data-analysis techniques:

- ✓ Partial Least Square – Structural Equation Modeling (PLS-SEM) based on Path Modeling.
- Obtaining latent measures (unobserved measures) of abstract constructs like “ES health”, or “Adequate living conditions” (Blue circles).
- Discovering cause-effect relationships between the latent variables and the measured variables (Indicators in yellow rectangles)



ES under analysis

Ecosystem
Services to be
valued





RESULTS BASED ON VALUATION SCENARIOS

Based on data analysis and stakeholders participation 



BASED ON A DETAILED ANALYSIS OF AGRICULTURAL PRACTICES IN COCOA PRODUCTION

- A preliminary **typology of agricultural practices** in Cocoa Production was developed for the Provinces of Guayas and Los Rios.
- Database: Encuesta de Superficie y Produccion Agropecuaria Continua (ESPAC, INEC-2014)
- Sample Size: 1.317 surveys.
- Unit of analysis: farm.

METHODOLOGY APPLIED FOR THE TYPOLOGY

- TWO-STEP Clustering based on estimation of the joint verisimilitude function, which allows combination of qualitative and quantitative information.
- Clusters were run separately (to improve quality results).
 - Group 1: Small farmers
 - Group 2: Medium and large farmers up to 100 has.

VALUATION SCENARIOS



SUMMARY OF TYPOLOGY

Group	Profile	Description	%
1. Small farmers	1	Use of modern and non-modern irrigation techniques; Exclusive use of chemical pesticides and fertilizers. Low yield.	50.25
	2	Non use of irrigation nor chemical pesticides or fertilizers. Low yield	45.24
2. Medium-Big size farmers up to 100 has.	1	Big size farmer, with technical use of irrigation. High use of chemical pesticides and fertilizers. Medium to high yield.	2.30
	2	Medium size farmers, with technical and non-technical use of irrigation. High use of chemical pesticides and fertilizers. Medium yield.	1.23
	3	Medium size farmers, with non-technical or non-use of irrigation and/or chemical pesticides and fertilizers. Low yield.	0.98

Key aspects for definition of Valuation Scenarios

- Not necessarily small farmers are ES friendly as neither medium or big farmers
- The higher the size of the farm the higher the importance of productivity (which may demand more agricultural inputs)
- Trade off between practices that improve productivity but may affect Ecosystem Services
- Differences in capacity to adopt agricultural practices that are ES friendly

VALUATION SCENARIOS

SCENARIO 0 (BAU)

- Marginal increase of the area of cocoa production in the Dauvin Irrigation project; agricultural practices do not change significantly and therefore there is not an increase (and eventually it is reduced) the production of ecosystem services. Regarding the irrigation project, this does not produce the expected benefits in relation to agricultural productivity, and improving the living conditions of the beneficiaries (rural poor).

VALUATION SCENARIOS

SCENARIO 1 (Unsustainable development path)

There is a significant increase in the area of cocoa production in the Dauvin Irrigation Project (50% of the area with mid to high agro-ecological conditions) with the same distribution of producers based on its size; but agricultural practices do not change, and therefore there is a reduction of ecosystem services. Regarding the irrigation project, this shows an improvement in productivity, but because of the unchanged practices, there is not an important improvement on living conditions related to environmental issues (particularly in the case of small farmers).

VALUATION SCENARIOS

SCENARIO 2 (Sustainable development path)

There is a significant increase in the area of cocoa production in the Dauvin Irrigation Project (50% of the area with mid to high agro-ecological conditions) with the same distribution of producers based on its size; Agricultural practices are changed, and therefore there is an increase of ecosystem services. Regarding the irrigation project, this shows an improvement in agricultural productivity, and also living conditions related to environmental issues are better (particularly in the case of small farmers).



COMMUNICATIONS FOR EFFECTIVE OUTREACH

Based on a defined strategy

QUESTIONS FOR POLICY DESIGN

Which technologies for cultivation, irrigation, crop protection, harvest, etc, should be promoted in the area?

Which practices can help to reduce the impact over the ecosystems?

Which institutional arrangements can help to have a sustainable irrigation system?

What socio-environmental aspects should be considered to reduce conflicts and improve the resilience of the ecosystems in the Dauvin area?

OUTREACH SO FAR...

- Presentation of advances at the First ESP Latin American Conference (Cali-Colombia, October 2016).
- Book chapter accepted for publication at “Cacao y campesinos: experiencias de producción e investigación”.
- Two local conferences with stakeholders and the academic community
- Interim Report to be presented in COP 13 (Mexico, Cancun)



FUTURE

- Final report
- At least two academic publications
- 1 video about the study
- 1 local workshop with stakeholders
- Booklet distribution among stakeholders
- Consultations with local and national authorities
- Classroom materials
- ...



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