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Understanding the effects of climate change on the livelihood strategies of small farmers of the Andean Region: A modeling approach

Vidal M.

Lima, 02 August 2011

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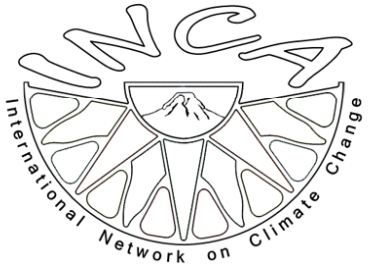
Presentation outline

1. General information about the research project
2. Methodology
3. Research progress
4. Next steps

1. General Information



Main research objective:

To analyze farmers' agronomic adaptation strategies to climate change and the effects of these strategies on the farmers' socioeconomic status. The focus is on traditional farmers of the Andean Region of Peru.

Specific objectives

Obj.1: To analyze past climate trends and elaborate future climate scenarios based on the detected trends.

Obj.2: To investigate how climate change impacts the livelihood strategies of local farmers.

*Obj.3:*Characterize the productive strategies farmers are using for coping with climate change, concretely: shelterbelts, irrigation, forest plantations, and change in the type of cultivar.

Obj.4: Simulate the probable adaptation responds of farmers to the proposed climate change scenarios.

Obj.5: To estimate the socioeconomic outcomes for each scenario.

Obj.6: Analyze the trade-off between the different adaptation strategies evaluated.

Research questions

Q1: Are there already signs of climate change in the study area? Of which kind?

Q2: Do farmers of the Andean Region have already been experiencing issues concerning climatic change? What is the nature of these issues?

Q3: Which productive strategies are being used by farmers of the Andean Region to cope with Climate Change?

Q4: Which farmers' adaptation strategies can be expected under the different future climate change scenarios? How will they develop in time?

Q5: How do the strategies adopted (in the different CC scenarios) will impact the socioeconomic status of the farmers at a household level?

Q6: What are the expected trade-offs between the different adaptation strategies under study?

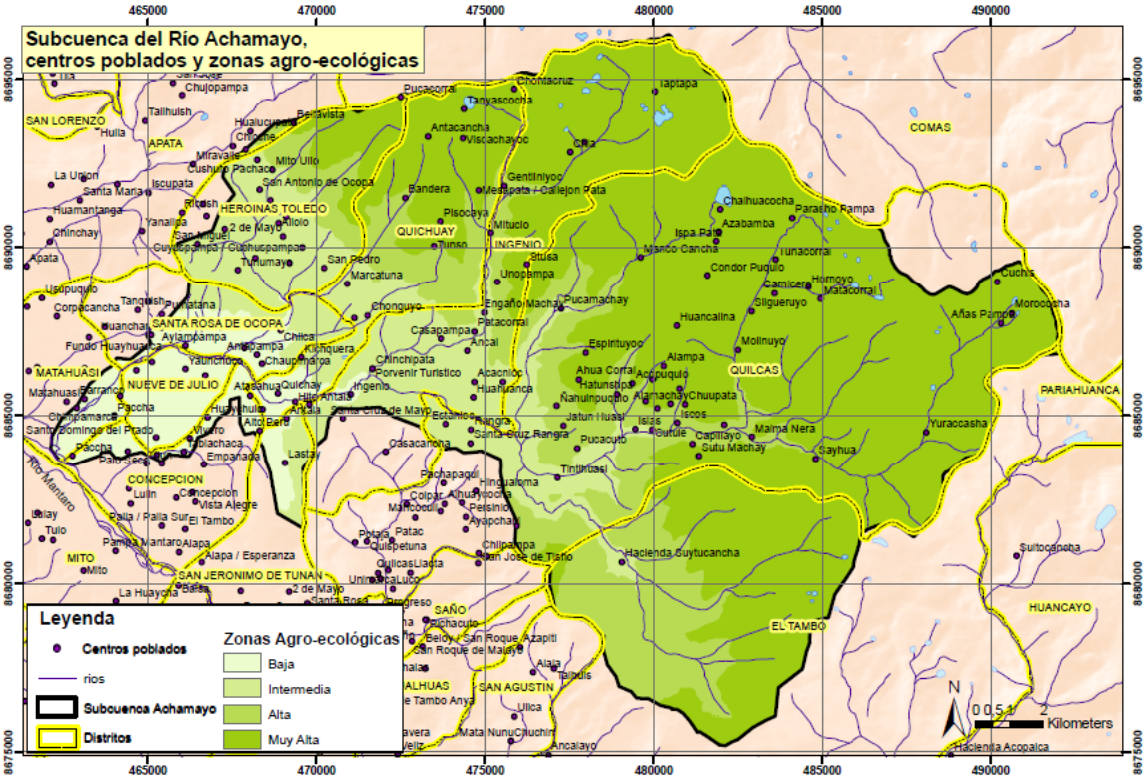
Research site: the Achamayo sub watershed

Area: ~248 sq. km

Population: ~ 17000

Altitudinal range : 3262 – 4500 masl

Precipitation: 800 – 1500 mm / year



2. Methodology

Main Tool: MP-MAS

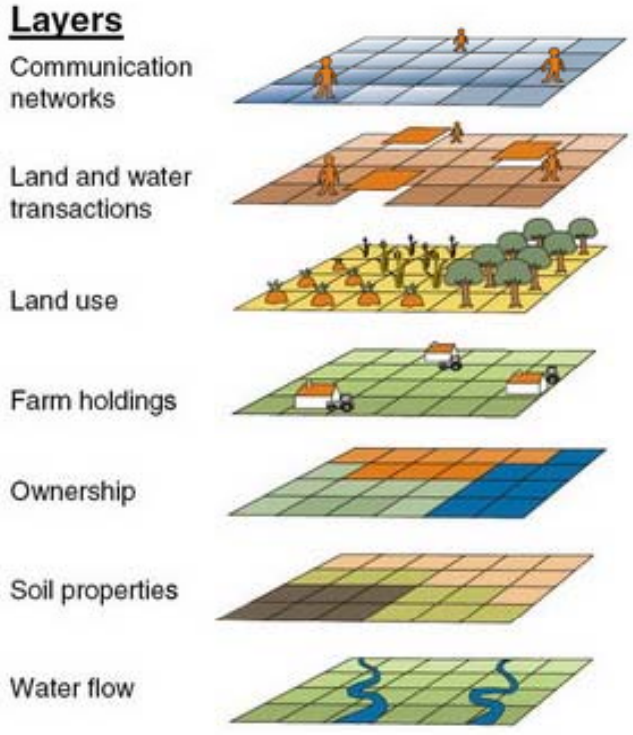
Name: Mathematical Programming-based Multi-Agent Systems (Version 2.0)

Developers: Berger, T. and P. Schreinemachers (2009) University of Hohenheim.

www.mp-mas.uni-hohenheim.de

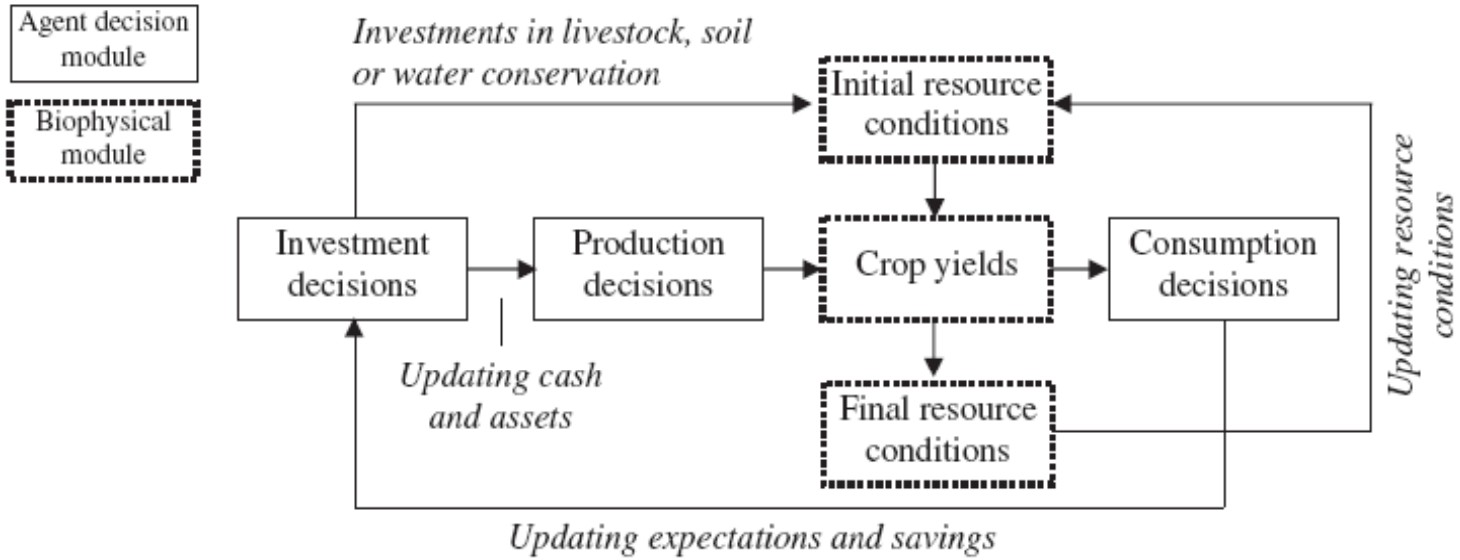
Used for simulating land use change in agriculture and forestry. It combines socio economic models of decision-making with biophysical models simulating the crop yield response to changes in environmental factors e.g. water supply, soil nutrients.

The model needs to be adapted (or complemented by another program) to also incorporate the effect of changes in T° , e.g. for frost events.



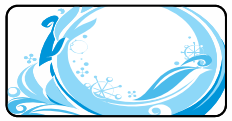
Spatial data representation

Human-environment interaction in MP-MAS



Source: Schreinemachers and Berger 2011

MP-MAS: Information requirement



Climate

- Historical weather records

✓ IGP

Population

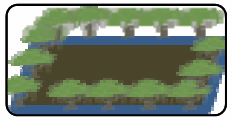
- Demographic composition
- Asset composition
- Location

✓ Field data

Households

- Composition (age, gender), size
- Assets (labour, land, animals, crops,…)
- Productive activities
- Education (household hh)
- Access to credit
- Land tenure
- Income sources
- Membership to organizations (…)

✓ Field data



Technologies

- Characteristics
- % of population currently using the technology
- Minimum investment

Ongoing
(Amos + field data)

Markets

- Production costs
- Selling and purchasing prices

✗ Field data

Land use

- Land use classification
- Soil clasiffication

Ongoing
(Medina + second. data)

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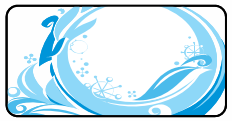

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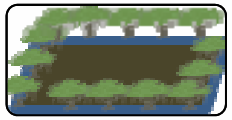

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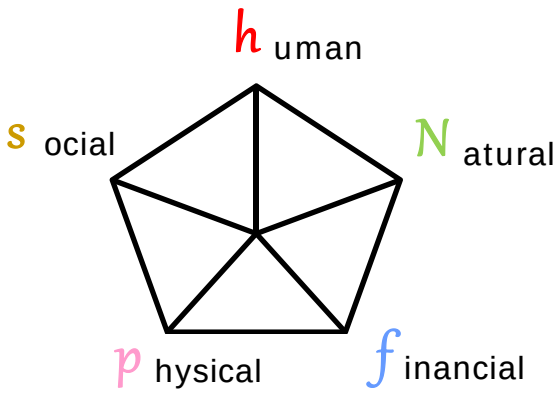
Ongoing
(Medina + second. data)

An example: indicators of the livelihood approach

Households

- h • Composition (age, gender)
- h • Size
- h • Productive activities: on-,off- and out-farm
- h • Education (household hh)
- f • Access to credit
- f • Income sources
- • Assets
  - f - livestock,
  - h - labour,
  - N - land,
  - N - farm animals
  - N - crops
  - f - trees
  - p - technologies
- N • Land tenure
- s • Membership to organizations
- s • Reciprocity

Sustainable Livelihood Capitals



3. Research Progress

- Data collection

- Data analysis

Data collection

a) Selection of the study site

b) Participatory workshops

c) Semi-structured interviews

d) Interview with key informants

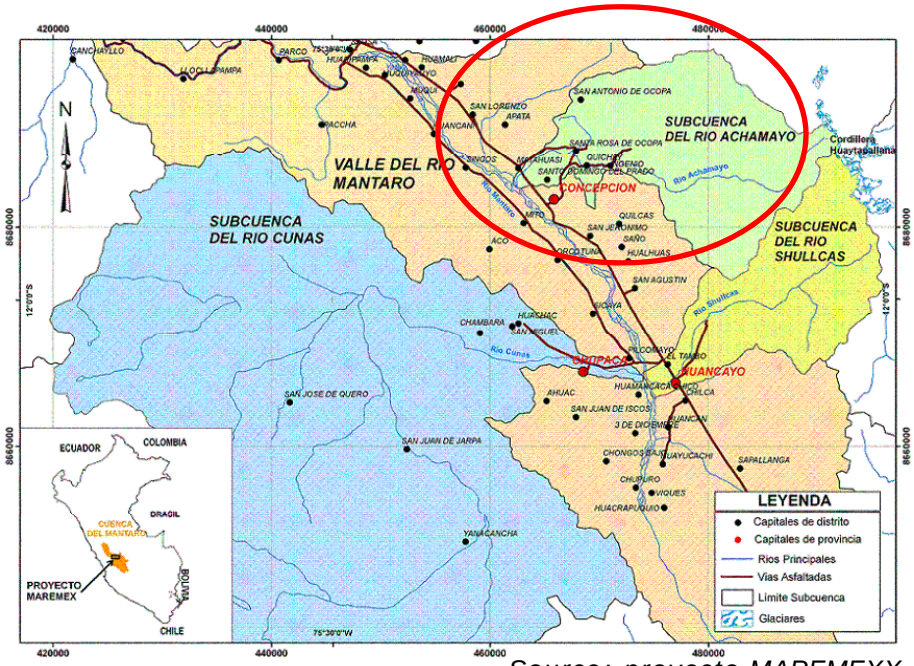
e) Frost research

f) Networking

a) Selection of the study site

- Literature review
- Definition of selection criteria
  - Evidence of climatic change affecting the livelihood strategies of farmers.
  - Agriculture is one of the main economic activities.
  - Traditional agricultural practices are still in use
  - Population is conformed by small-farmers
  - Forestry is a complementary economic activity
- Meetings with key informants

  → IGP, Agrorural
- Field visits to watersheds



Source: proyecto MAREMEXX

b) Participatory workshops

- 5 participatory workshops in:
  - ✓ Marcatuna
  - ✓ La Libertad
  - ✓ San Antonio
  - ✓ San Pedro

- Main information collected:
  - ✓ Seasonal calendars for agriculture and forestry
  - ✓ Perceptions about climate in the past, present and future
  - ✓ Transects of the community, thematic maps
  - ✓ Agricultural production and costs
  - ✓ Main productive problems

c) Semi-structured interviews

- 70 semi-structured intervies at household level were conducted in:
  - ✓ Marcatuna
  - ✓ La Libertad
  - ✓ San Antonio
  - ✓ San Pedro
  - ✓ Santa Rosa de Ocopa
  - ✓ Huanchar

- Ongoing:
  - ✓ Quilcas (Huancayo) – 15 interviews
  - ✓ Ingenio (Huancayo) – 15 interviews
  - ✓ Quichuay (Huancayo) – 15 interviews
  - ✓ Nueve de Julio (Concepción) – 15 interviews

d) Interview with key informants

- IGP
  - ✓ Ing. Raúl Yaranga
  - ✓ Ing. Enma Nuñez
  - ✓ (...)

- AgroRural
  - ✓ Ing. Francisco Amaro Salazar, Director Zonal Junín
  - ✓ Ing. Daniel Torpoco, Esp. Manejo RRNN DZonal Junín-Huancayo-Peru
  - ✓ Ing. Guillermo Malpartida Lagos – jefe de la Agencia Zonal Concepción-Jauja
  - ✓ Ing. Miriam Vergara, Esp. Forestal Agencia Zonal Concepción-Jauja

- INRENA
  - ✓ Ing. Luis Baldeón Jara, Adm. Forestal y de Fauna Silvestre-Sierra Central

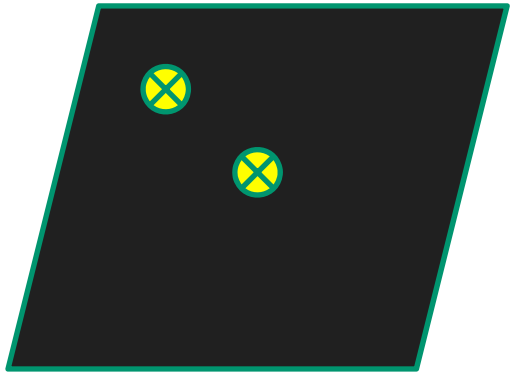
- ANA

- Municipalidades
  - ✓ Heroínas Toledo
  - ✓ Santa Rosa de Ocopa

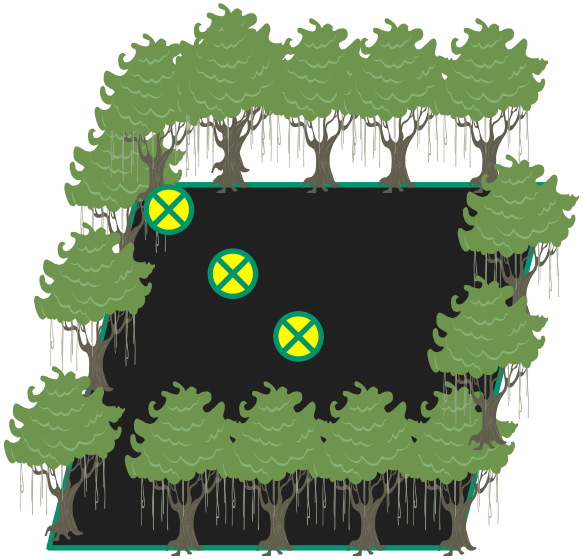
e) Example for adaptation strategies: frost research

- Research question: Does shelterbelts contribute to increase the minimum temperature during frost events, therefore, protecting crops against them?

Agricultural plot

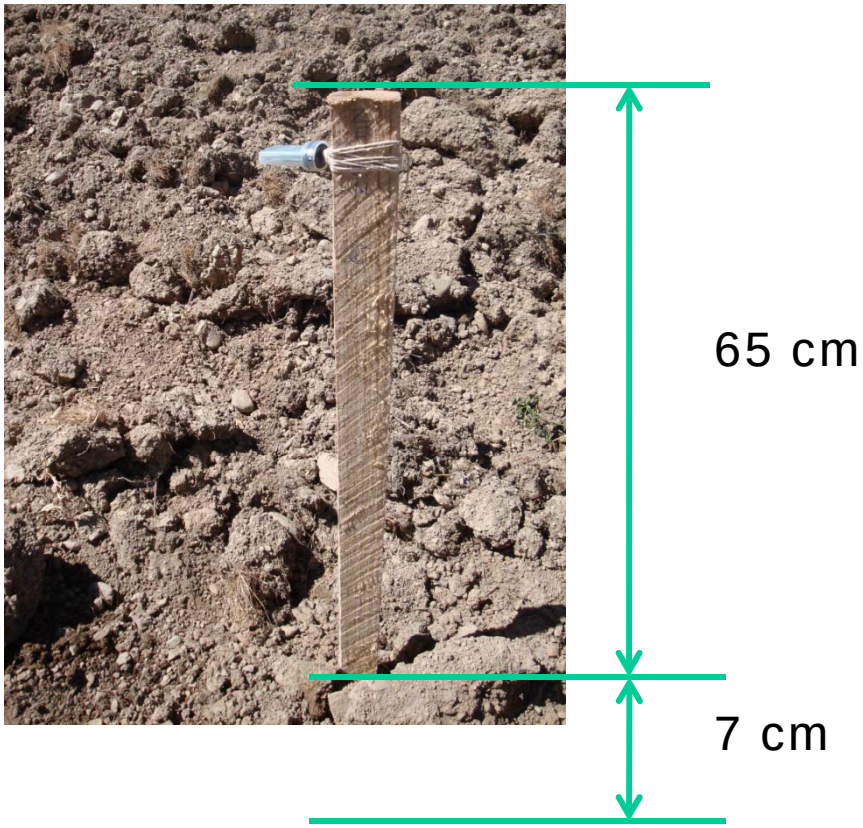


Agroforestry plot



-Registration of minimum temperature during frost events

e) Frost research (...)



- Also: ongoing research of the effects of shelterbelts on droughts (Msc. Jost)

f) Networking

Investigadores trabajan.

Investigan calent

Las investigaciones se inic
el apoyo de una tesista y ur
Universidad Nacional del C

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iga cambio climático y

s forestales de la Universidad Técnica
los efectos del cambio climático en la
ormó el Programa de Desarrollo

el Instituto de Forestería Internacional y
haften, Technische Universitat Dresden.

para promover la investigación,
restales, en la vulnerabilidad,
como parte del proyecto International

recorrió la zona de estudio y presentó al
al Merino, François Jost Vargas,
sch Medina, quienes hacen doctorados y

con el Ingeniero Daniel Torpoco Rojas,

cia Zonal Concepción - Jauja, con el
iencias Agrarias de la Universidad

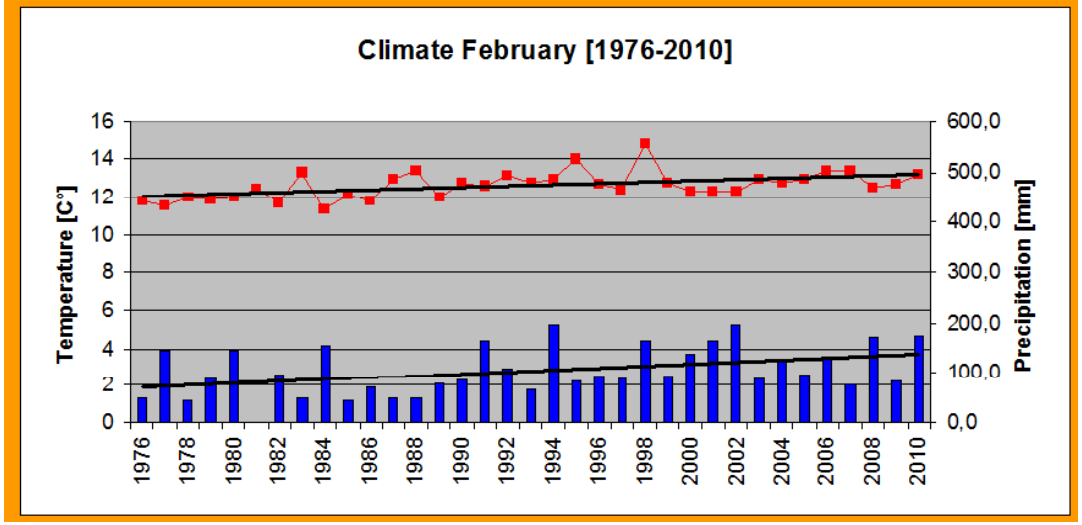
s, según dieron a conocer los
sch del Instituto de Forestaría

Data analysis

a) Weather data analysis

Preliminary tests have been done in cooperation with Bach. Steffen Gedan

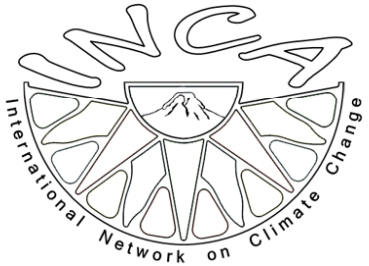
Trendanalyse Temperatur/Niederschlag



Data source: Gedan 2011 (in litt.)

- Average Max and Min Temperature have significantly increased (with exception of May, juni and July)
- No significant variations in the annual amount of precipitation
- Rainny days per year have significantly increased
- Frost days per year significantly reduced

4. Next steps



Schedule

No.	Actividad	2011						2012											
		J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
1	Presentation of the final research proposal																		
2	Kolloquium 1																		
3	Visit to Hohenheim for learning MP-MAS (HOHENHEIM)																		
4	First parametrization of the model																		
5	First simulation experiments and data analysis																		
6	Kolloquium 2																		
7	Data collection (PERU)																		
8	Model preliminary implementation																		
9	Kolloquium 3																		
10	Modification of the model to fit the objectives of the study																		
11	Simulation experiments with the adapted version of MP-MAS																		

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MUCHAS GRACIAS!

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Manejo de Riesgos ante Eventos Meteorológicos Extremos como Medida de Adaptación ante el Cambio Climático en el Valle del Mantaro
AREMEX ANTARO
Instituto Geofísico del Perú

COLERE CUDIO HOMINEM ET AGRUM

AGRORURAL

MP MAS : application examples

Research questions addressed in MP-MAS applications

Country	Research question	Key references
Chile	What would be the impact of water pricing on the efficiency of irrigation water use and land use dynamics?	Berger et al., 2007; Berger, 2001
Germany	What could be the impact of climate change on land use and farm incomes?	Berger et al. 2010
Ghana	What would be the impact of a transition from rain fed to irrigated agriculture?	Birner et al. 2010
Thailand	What would be the impact of four fruit tree technologies (fruit drying, artificial flower induction, extended shelf-life, and improved irrigation) on land use, erosion and levels of pesticide use?	Schreinemachers et al., 2009, 2010
Uganda	What would be the impact of hybrid maize varieties and better access to farm credit on poverty and environmental sustainability?	Schreinemachers et al. 2007, Schreinemachers, 2006
Vietnam	How would the adoption of soil conservation measures affect short- and long-term household incomes?	Quang et al., 2010

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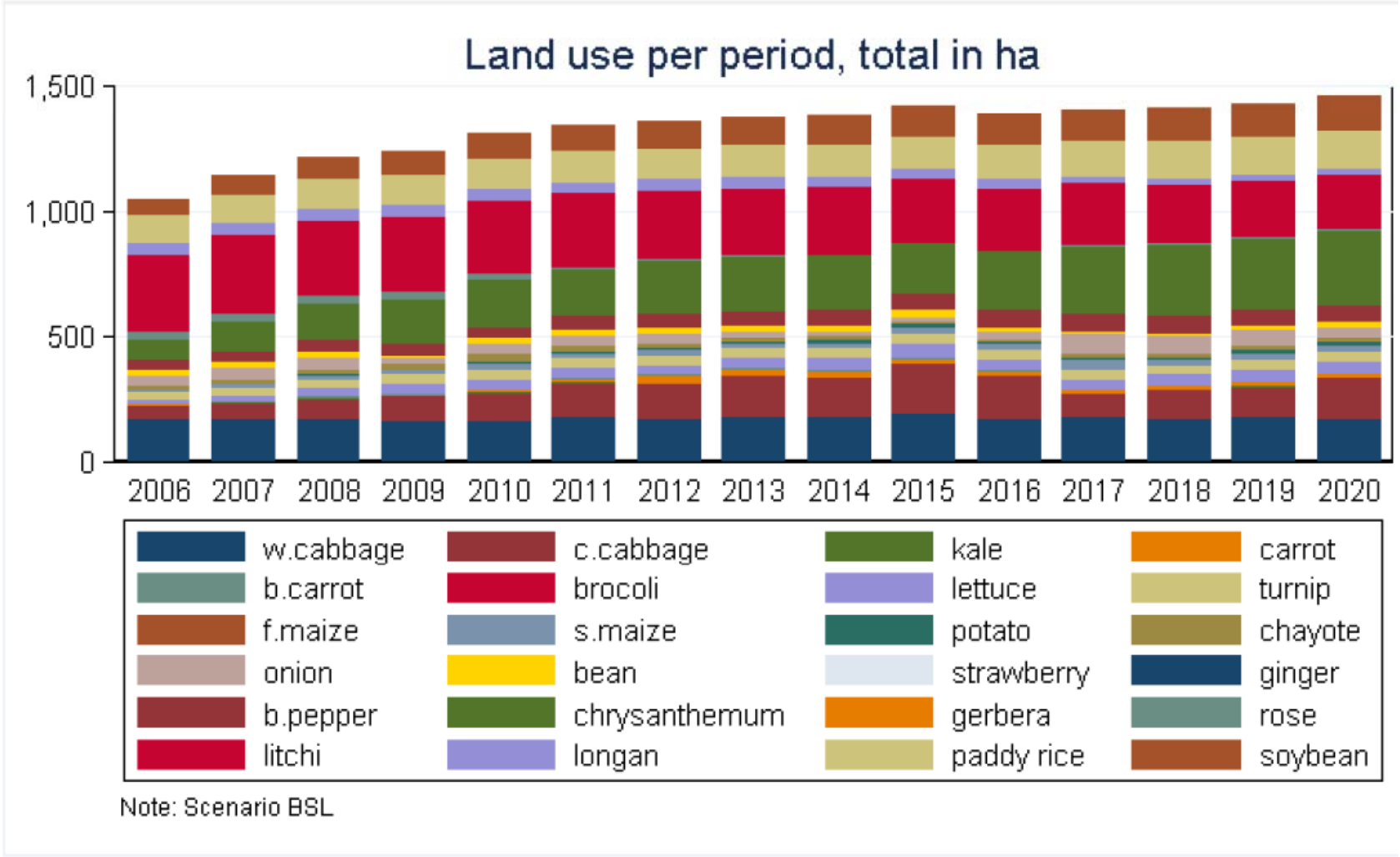
Example of a watershed in Thailand: how introduction of technologies affect land use



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Example of a watershed in Thailand: how introduction of technologies affect economical and environmental criteria

Table 4 Results for alternative fresh fruit prices, with and without innovations, average values 2006-2020 expressed as index numbers (baseline scenario=100).

Fresh litchi price	Litchi orchard area		Household income		Pesticide loads		Erosion soil loss	
	with	without	with	without	with	without	with	without
6 bt/kg	98	94	100	100	100	101	101	101
9 bt/kg	106	100*	100	100*	97	100*	98	100*
12 bt/kg	124	111	99	99	94	98	94	97
15 bt/kg	140	122	98	98	90	94	89	92
18 bt/kg	148	132	101	98	86	92	87	89
21 bt/kg	153	139	104	99	85	90	86	86
24 bt/kg	156	145	108	102	84	89	85	85

*Note: * Baseline scenario (same as in Table 4).*