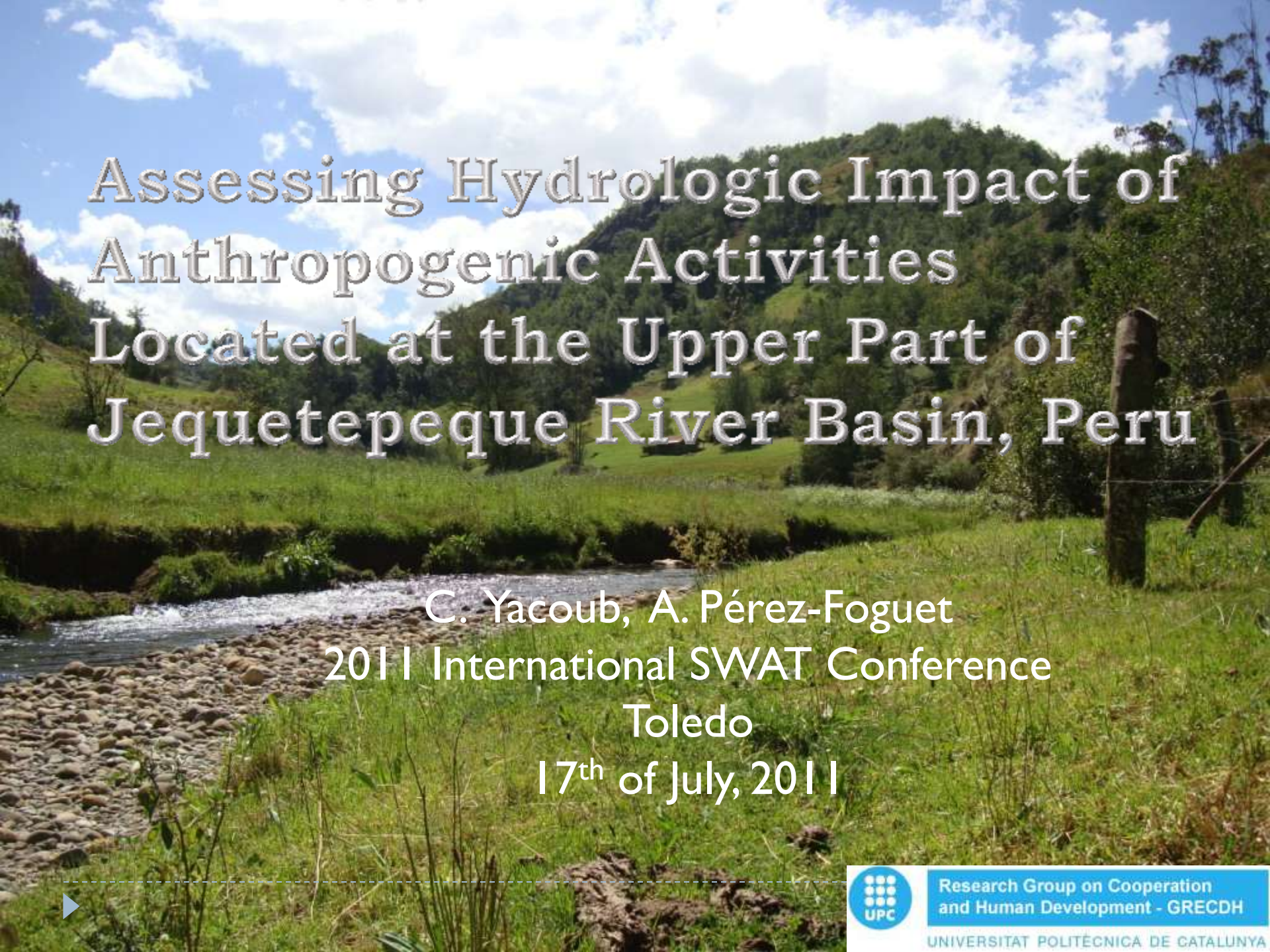

Assessing Hydrologic Impact of Anthropogenic Activities Located at the Upper Part of Jequetepeque River Basin, Peru

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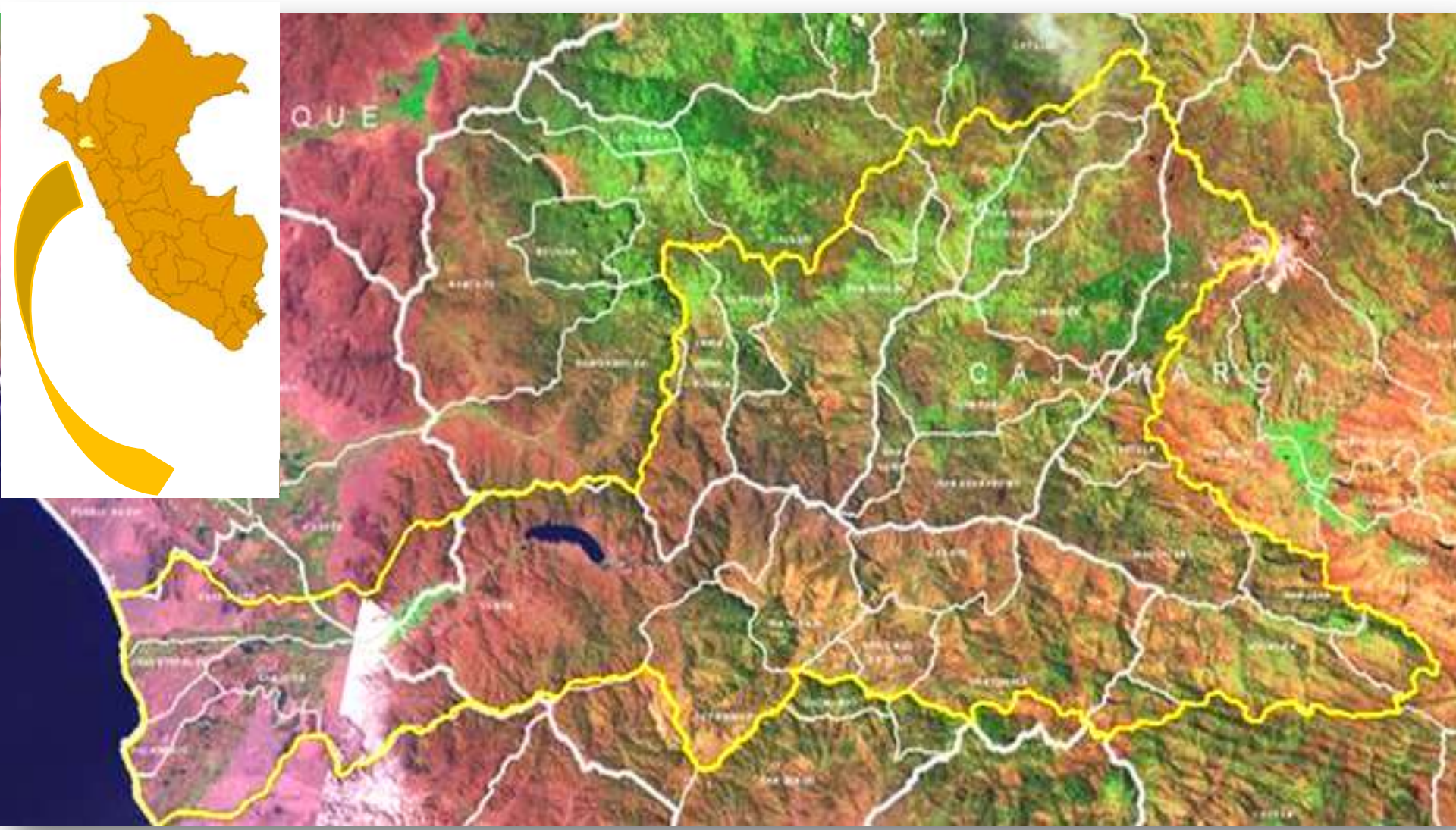
Research Group on Cooperation and Human Development - GRECDH

UNIVERSITAT POLITÈCNICA DE CATALUNYA

Outline of presentation

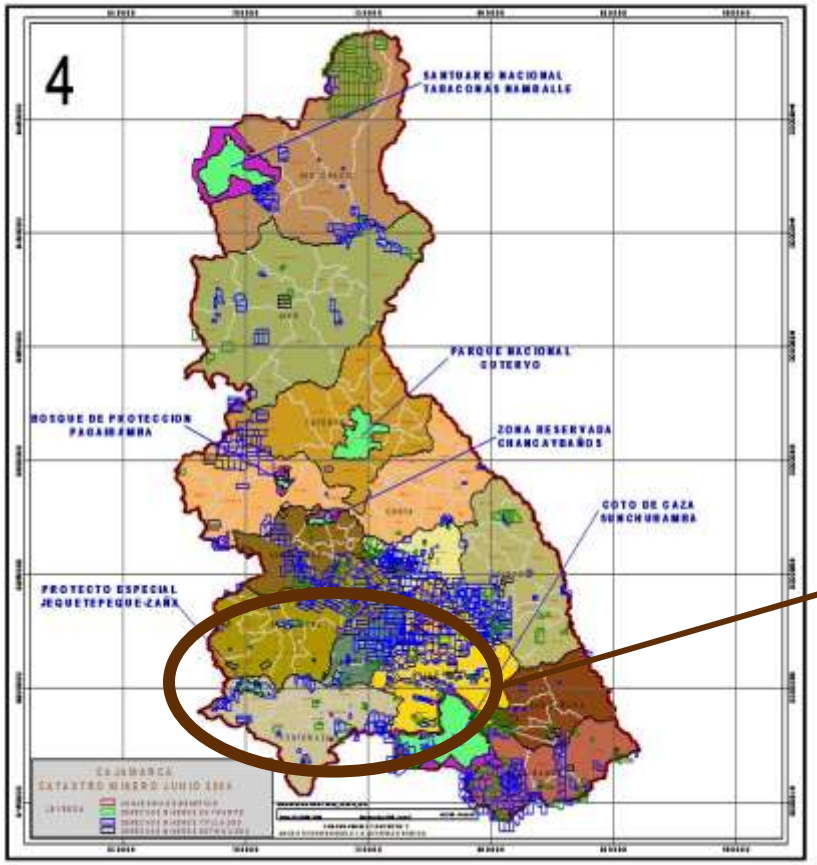
- Introduction
- Objective
- Model application
- Impact assessment
- Conclusions

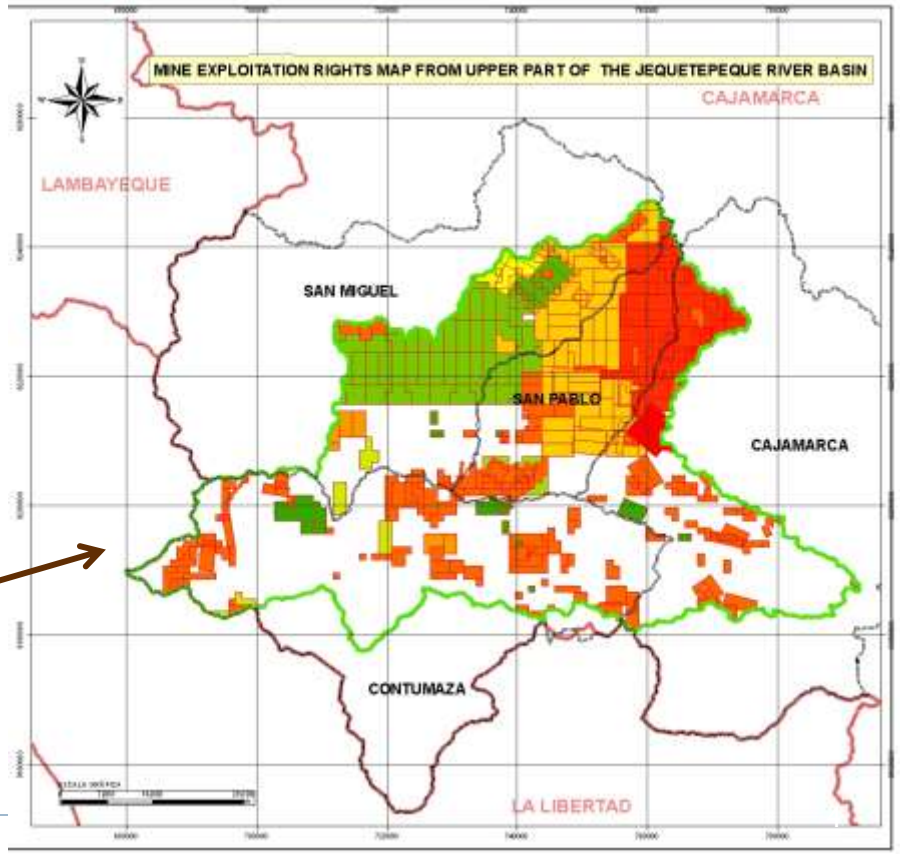
Location of the study area



Study Area

- Cajamarca is the second region with more mine sites of the country: 2.816 mining concessions (more than 30% of the region surface)





Introduction

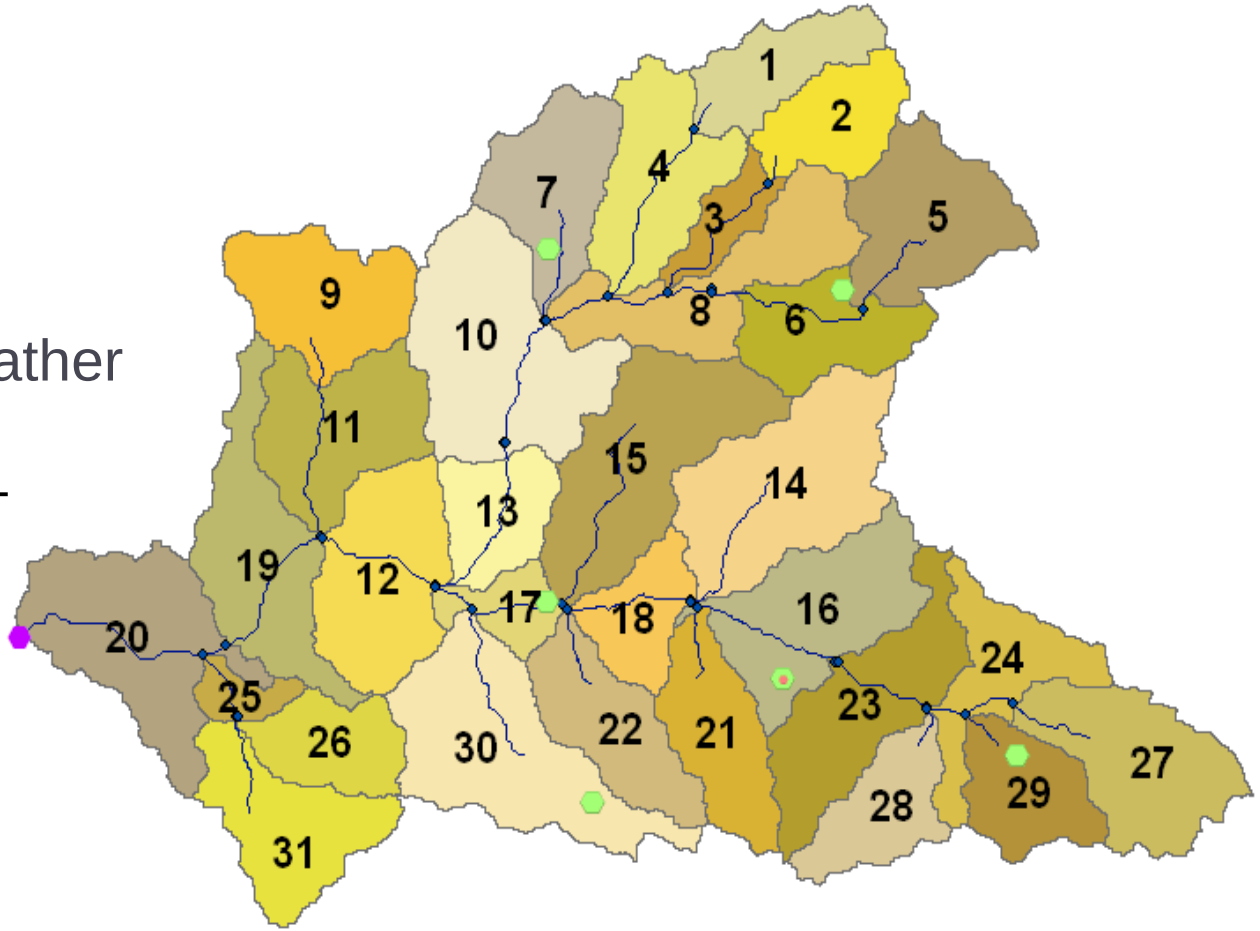
- Cajamarca region data:
  - 13 provinces and 128 districts.
  - Superficial area of 33.712 km² (2.7% of Peru)
  - 1' 359.023 inhabitants (5.2% of Peru) with a population density of 42 inhabitants/km²
- It is one of the most impoverish region of the country:
  - 75.6% of population is rural
  - 47% of child malnutrition
  - 37% of population without water access
  - 68% of population without electrical access

Objectives

- The aim of this study is to evaluate the contributions from wetlands, lakes, future mine sites and other anthropogenic activities in the upper part of the Jequetepeque River Basin

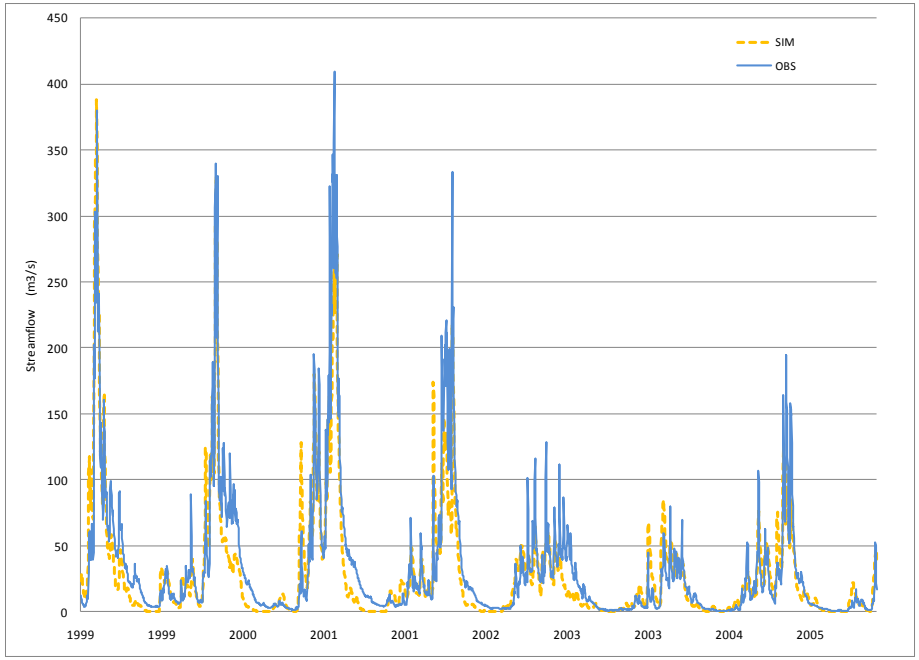
Model preparation

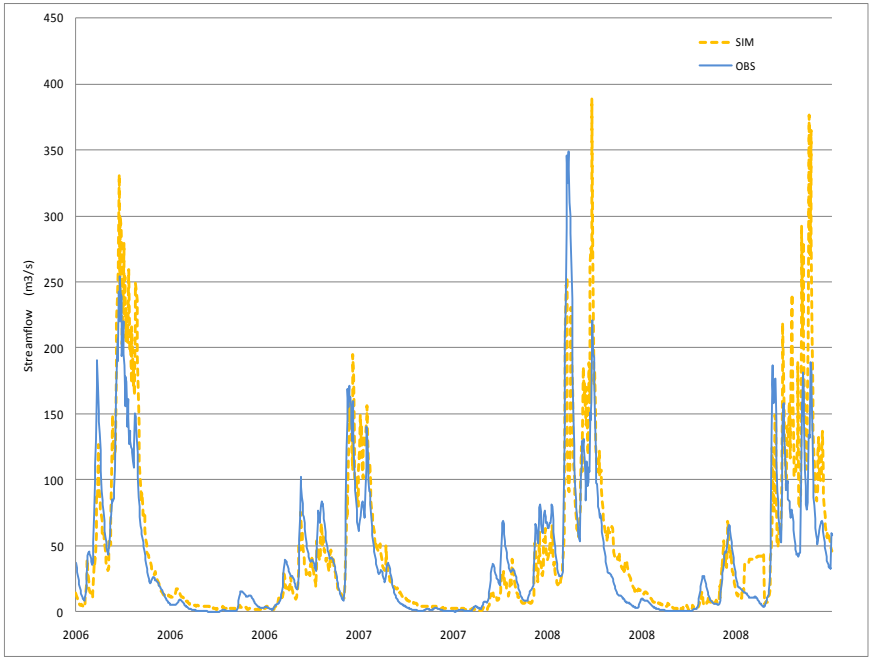
- DEM. 90 x90 m.
- Land use
- Soil Use
- Slope
- Hydrological and weather gage stations:
  - Daily min. and max. T (1 gage station)
  - Daily Rainfall (6 gage stations)
  - Daily Flow (1 gage station)



Model calibration

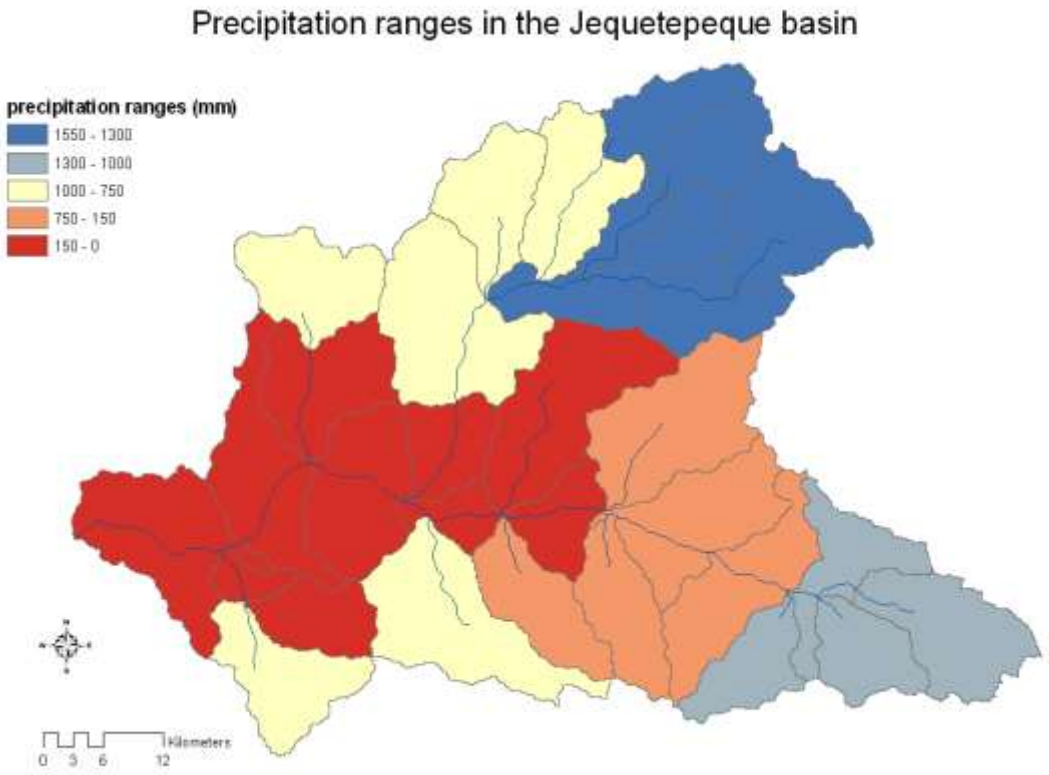
	NSE	RSR	PBIAS
Calibration	0.87	0.37	9.4%
Validation	0.72	0.53	10%





Definition of critical areas

- Sub-basins 1, 2 and 5 present around 250 lakes and 421 ha of sensitive wetlands. This water production area presents a double effect:
  - Provides the largest contribution in terms of amount water throughout Jequetepeque basin.
  - Cumulative flow is significantly higher for this area than for the rest of the basin in dry season.

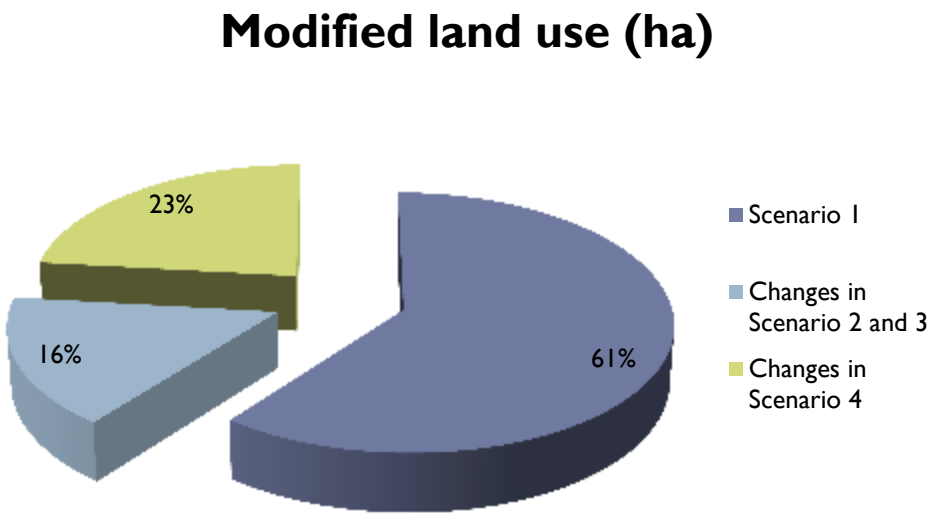


Definition of critical areas

- Social conflicts are present at these areas due to mine concessions that could affect the hydrology of these areas and perhaps also the basin.
- Local goverment and NGOs are interested on forestation due to its possible conservative effect of the area of concern.

Impact assessment

- Hydrological basin impact is evaluated by comparing streamflow and water yield from scenario 1 with the rest of scenarios simulated.
- Comparisons between land uses were carried out using the average streamflow and water yield for the simulation period.
- We summarize three main activities in the critical areas obtaining:
  - Sustainable agricultural and livestock (Scenario 1)
  - Forestation (Scenario 2)
  - Mining (Scenario 3 and 4)



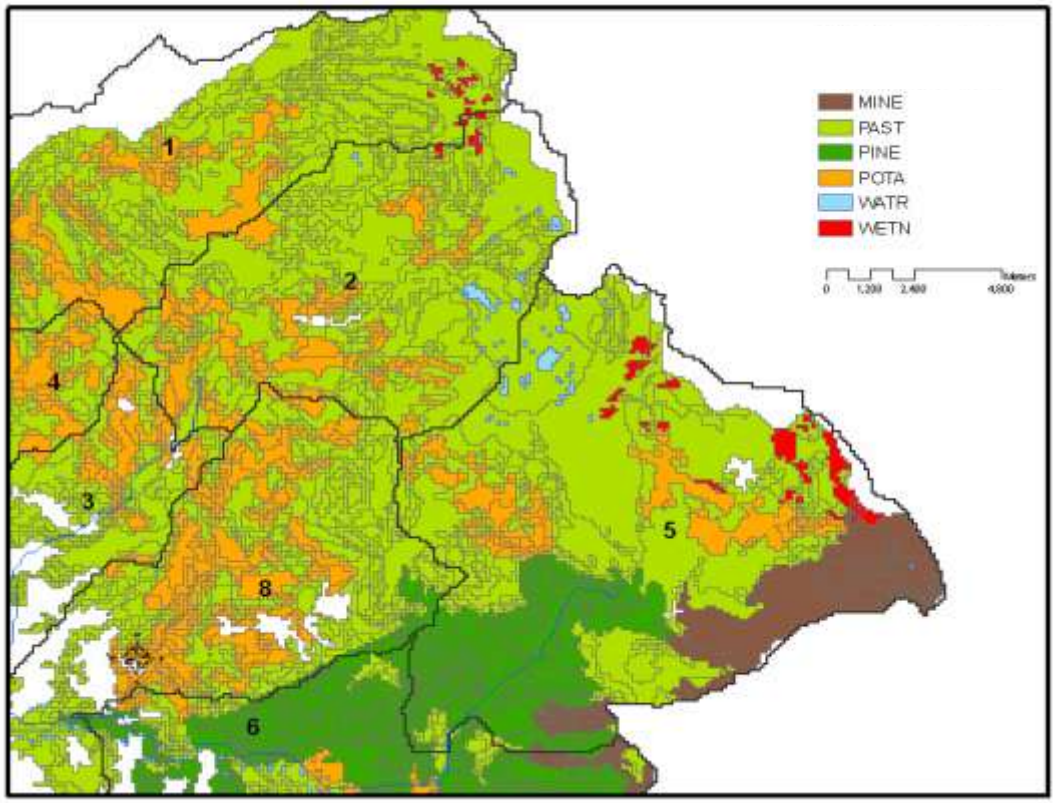
Scenario 1: sustainable agricultural and livestock

- Actual land use in the upper part of Jequetepeque river basin is sustainable nowadays. Wetlands, pastures, and potato crops are defined as land uses environmentally sustainable.
- Wetlands, pastures, and potato crops are defined as land uses environmentally sustainable.

	Sub-basin 1		Sub-basin 2		Sub-basin 5	
	ha	% subc	ha	% subc	ha	% subc
PAST	2459.9	32.3	2122.2	28.1	2156	13.2
WTLN	56.2	0.7	36.8	0.5	328	2.6
POTA	1550.1	20.4	1489.2	19.7	0	0

Scenario 2: Forestation

- Scenario 2 evaluates land use changes from pastures and wetlands to pine forestation.
- Changes of crops are not considered in this scenario due to crops are a livelihood for rural peasants of these critical areas.



Scenario 3 and 4: Mining

- Scenario 3: Wetlands and pastures are changed to mining, taking into account the same criteria as in scenario 2 (the same HRUs for all the soil types with slope ranges between 15 and 49%).
- Scenario 4 changes **all uses** present in the selected critical areas, for all types of soil and slope class with an exception: pine plantations.

	Sub-basin 1		Sub-basin2		Sub-basin 5	
	ha	% sub.	ha	% sub.	ha	% sub.
Scenario 2 and 3	2516.1	33.0	2159.0	28.6	2484.0	15.7
Scenario 4	4066.2	53.4	3648.1	48.3	2484.0	15.7

Impact assessment

- Hydrological basin impact is evaluated by comparing streamflow and water yield from scenario 1 with the rest of scenarios simulated.
- Comparisons between land uses were carried out using the average streamflow and water yield for the simulation period.

Sub-basin	Average stream flow (m^3/s)	Average WYLD (mm H_20)	Cumulative WYLD (mm H_20)
1	0.01	0.040	0.481
2	0.01	0.029	0.343
5	0.01	0.022	0.260
8	0.04	-	-
19	0.02	-	-

Scenario 2 vs Scenario 3

Sub-basin	Average stream flow (m^3/s)	Average WYLD (mm H_20)	Cumulative WYLD (mm H_20)
1	0.01	0.040	0.481
2	0.01	0.029	0.343
5	0.01	0.022	0.260
8	0.04	-	-
19	0.02	-	-

Sub-basin	Average stream flow (m^3/s)	Average WYLD (mm H_20)	Cumulative WYLD (mm H_20)
1	1.39	4.01	48.13
2	1.02	2.96	35.56
5	0.80	1.37	16.42
8	3.15	-	-
19	3.11	-	-

Scenario 3 vs Scenario 4

Sub-basin	Average stream flow (m^3/s)	Average WYLD (mm H_20)	Cumulative WYLD (mm H_20)
1	1.39	4.01	48.13
2	1.02	2.96	35.56
5	0.80	1.37	16.42
8	3.15	-	-
19	3.11	-	-

Sub-basin	Average stream flow (m^3/s)	Average WYLD (mm H_20)	Cumulative WYLD (mm H_20)
1	3.76	10.77	129.19
2	3.67	10.59	127.09
5	3.44	5.86	70.28
8	10.59	-	-
19	10.45	-	-

Conclusions

- The upper part of the basin has a crucial role providing hydrological response.
  - It represents the largest contribution in terms of amount water
  - Its water donor role is especially important in dry season
- Simulated scenarios with different land were made in order to assess the impact on hydrological contributions due to land use changes in these areas:
  - The current use of the basin is the most sustainable, featuring the largest amount of water stored.
  - Pine forestation presents almost no change in the hydrological behavior comparing with agriculture and livestock.

Conclusions

- Hydrological basin shows faster response if the land use is mining;
  - deteriorates the basin as a natural unit of renewal and water distribution in the territory,
  - increases the risks of soil erosion that can cause flooding and landslides.
- The preservation and conservation of this critical area should be considered decisive in the basin in hydrological terms
  - Assessing differences between production activities as water works, flood irrigation, mining, deforestation or reforestation and intensive farming.

Thank you very much for you attention!