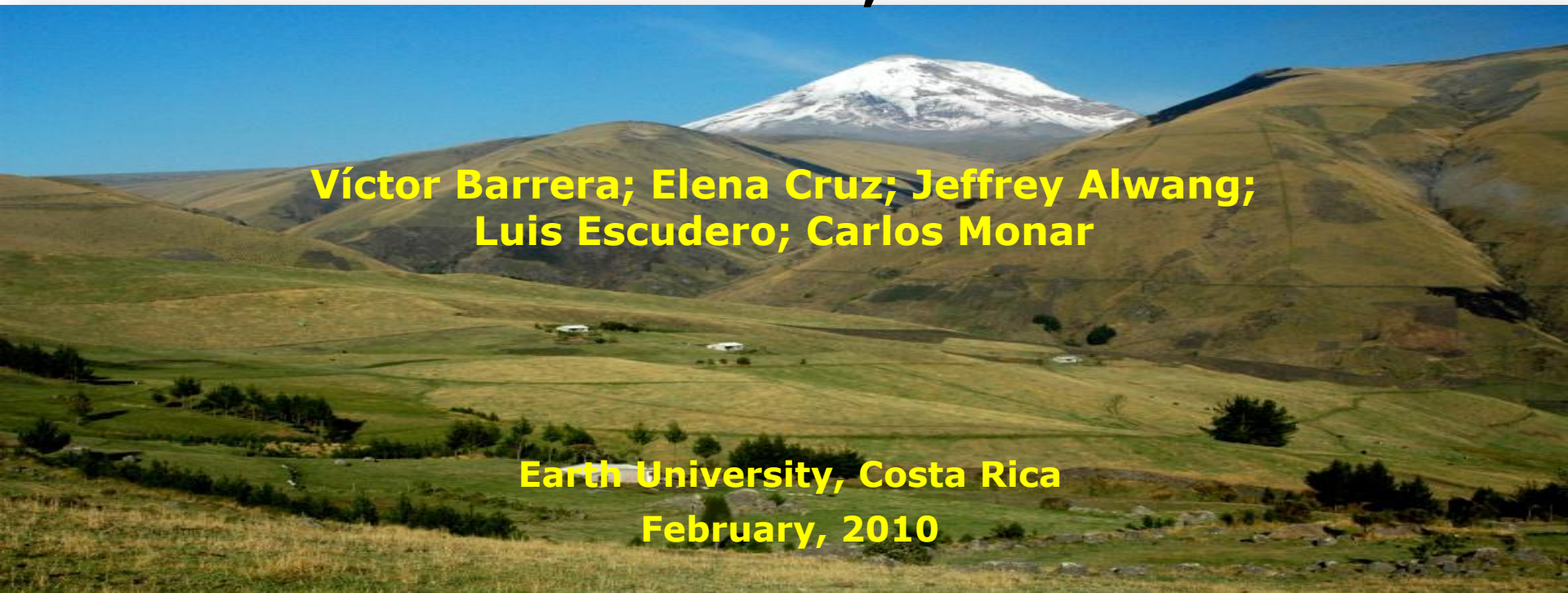
Finding means to promote the integrated management of natural resources in the sub watershed of the Chimbo River, Ecuador



Víctor Barrera; Elena Cruz; Jeffrey Alwang;
Luis Escudero; Carlos Monar

Earth University, Costa Rica

February, 2010

Ecuador: Major Floods in Low-lying Areas 2009

Photos from "El Comercio", January, February, March, 2009

- **Agricultural losses due to floods exceeded $160 millones (MAGAP, 23 February 2009).**
- **More than $ 1 Billion needed for rehabilitation of damaged infrastructure and other costs in the flooded regions (MICSIE, 5 March 2009).**

Primary Problem

Poor management of natural assets in the highland Andean zones has contributed to the flooding problems in the low-lying areas.

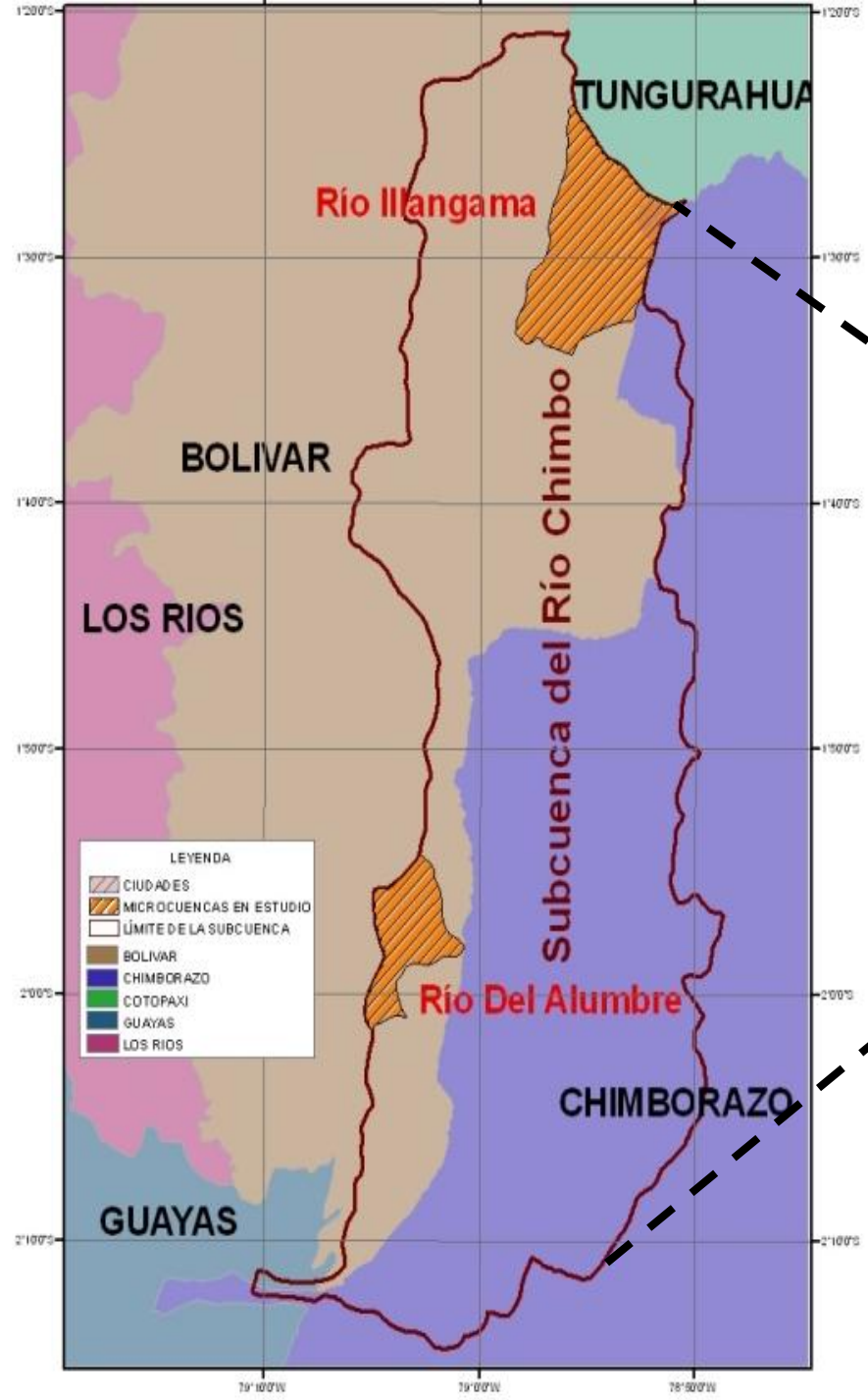
Would it be more cost-effective to avoid flooding damage than pay costs *ex post*

Integrated management of natural resources in small-scale agriculture in Andean Region of Ecuador

General Objective

Use integrated resource management tools and adaptive watershed management practices to achieve sustainable development in the Andean Region

Sub watershed of the Chimbo River, Ecuador



Sub watershed of the Chimbo river: 3635 km^2

Micro watershed of the Illangama river: 130 km^2

Micro watershed of the Alumbre river: 65 km^2

General conditions in the Chimbo sub watershed

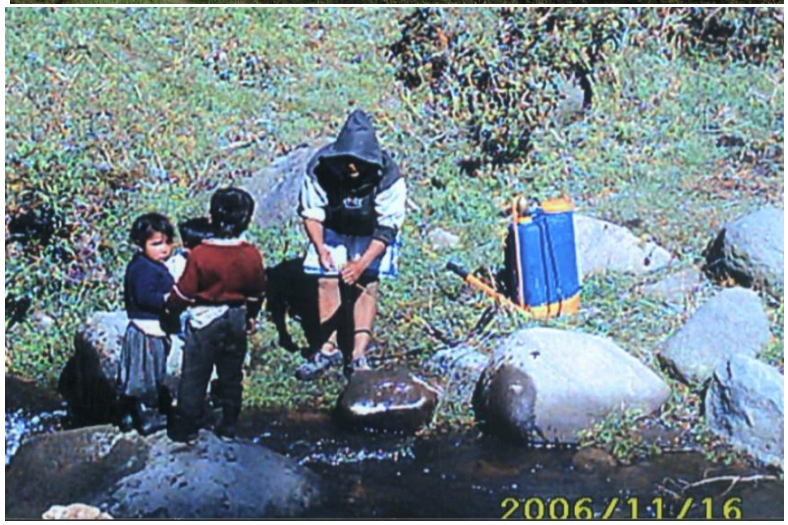
- Provide between 30 and 40% of the total water into the Guayas River.
- Three distinct ecological regions (paramo, high plain and subtropical).
- Range from 300 to 4500 meters in elevation and receive between 500 and 4000 millimeters of annual rainfall.

Profile of socioeconomic conditions in the sub watershed

Condition	Units	Bolívar
Population	Number	169370
Illiteracy	% (15 years and greater)	17.5
Education levels	Years	5.4
Economically active population	Number	61750
Percentage unsatisfied basic needs	% (total population)	76.5
Malnutrition	% (< 5 years)	61.3

Enviromental conditions in sub watershed

- High rates of erosion contribute to sedimentation and turbidity in the water (8’000000 MT/Year).
- Substantial reduction in water levels and flows caused by rampant deforestation and expansion of the agricultural frontier.
- Agro-chemical contamination of surface waters caused by runoff from cultivation on steep slopes, limited ground cover, and intensive tillage.

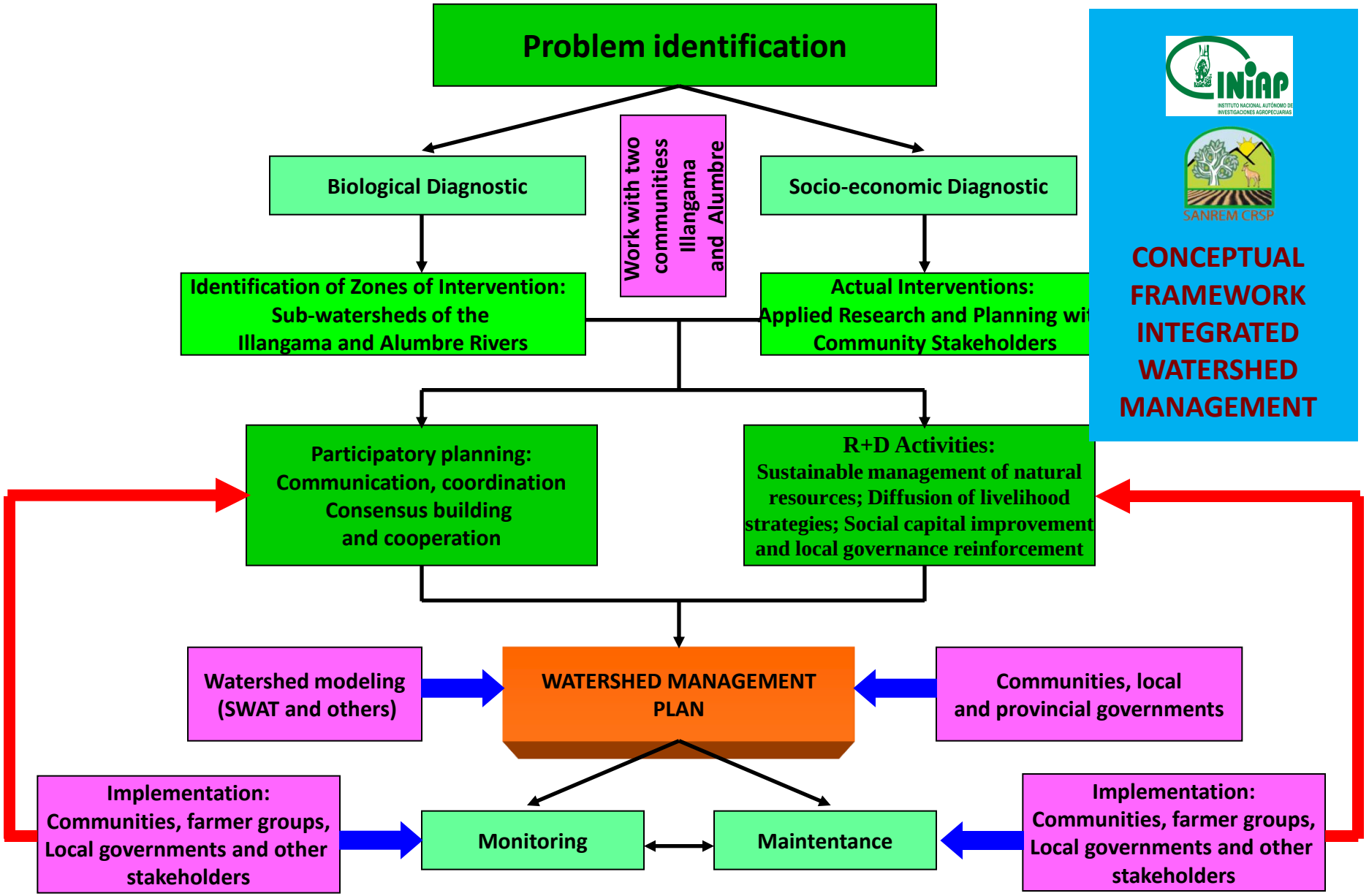


INTEGRATED ADAPTIVE WATERSHED MANAGEMENT

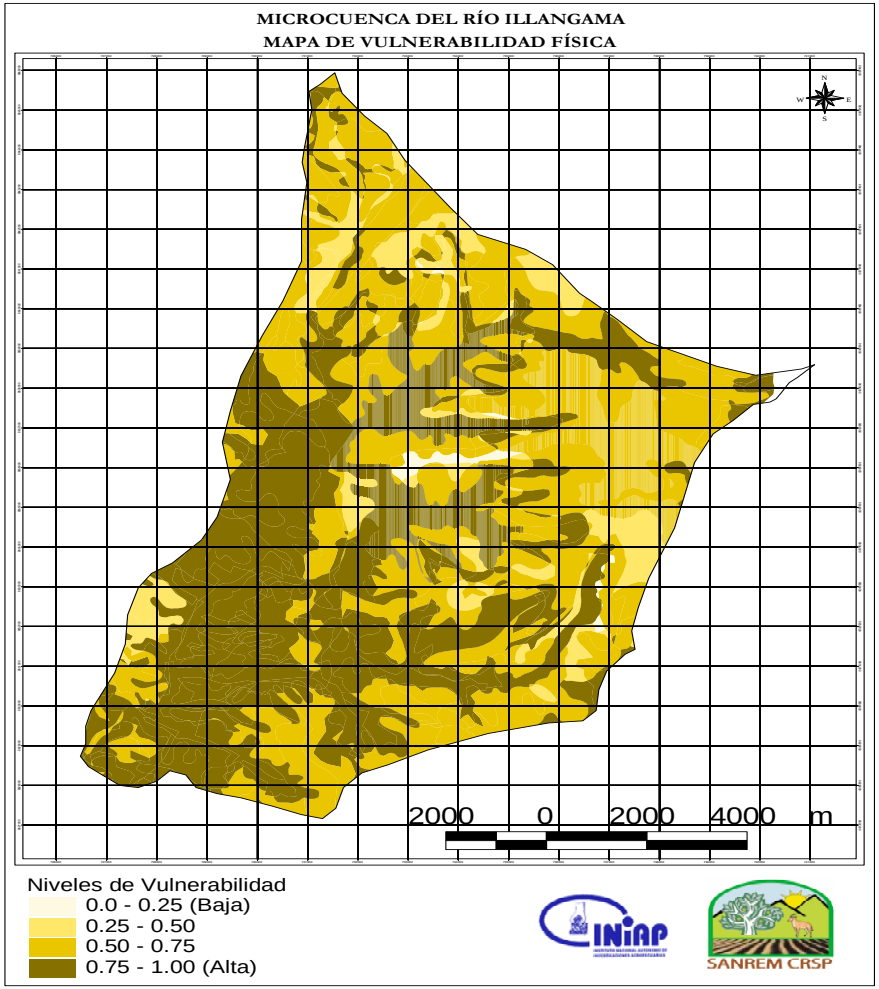
Promote the appropriate use of natural resources, seeking an equilibrium between economic growth, equity and environmental sustainability with an overall objective of improving quality of life for human populations (Jiménez *et al*., 2006).

Continuous management of watersheds using application of scientific techniques in coordination with local actors (USEPA, 2006)

Integrated Management of the Chimbo



Vulnerability mapping

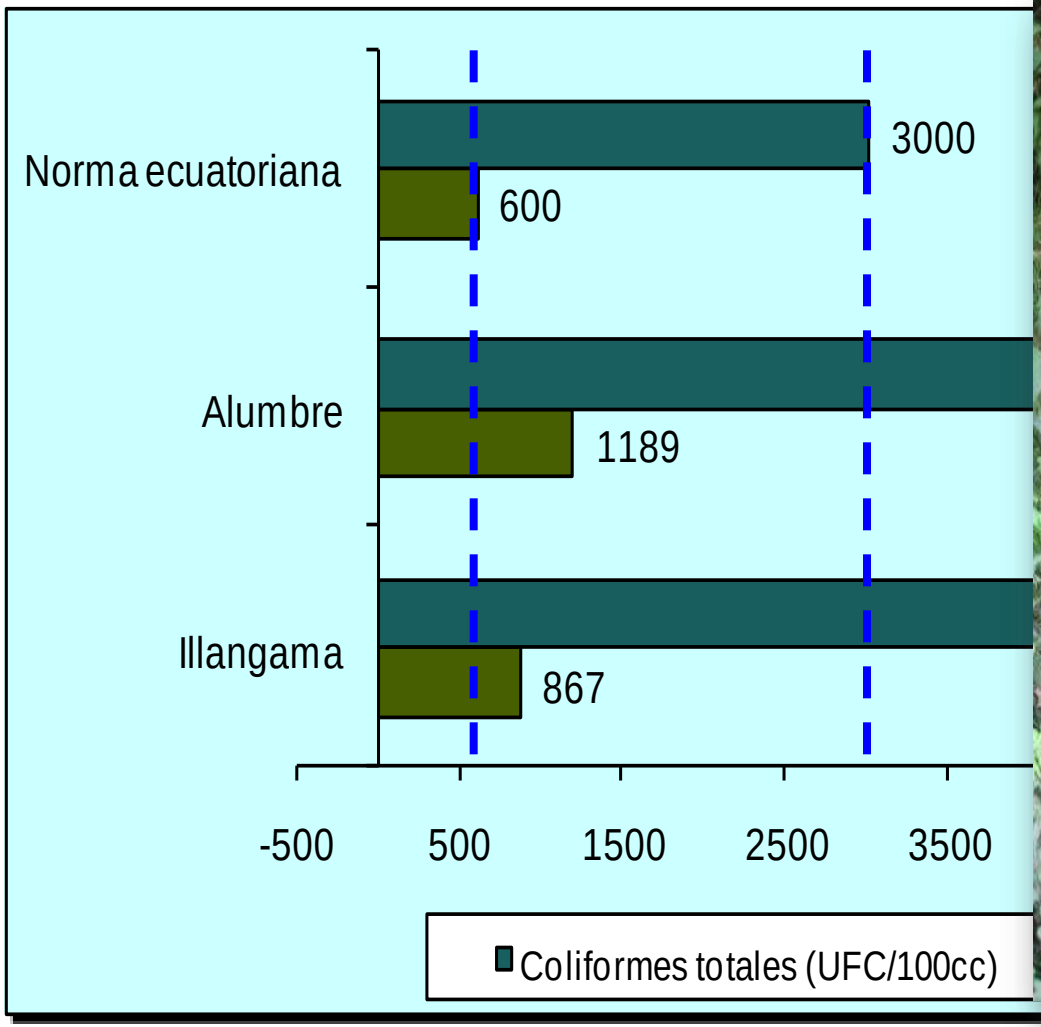


- **Based on GIS overlays of variables including: slope and erosivity, current land uses, soil cover, population pressures, others.**
- **More than 3664 ha in Illangama and 2259 ha in Alumbre are "highly vulnerable".**
- **Local governments have begun process of reforestation in vulnerable areas and water-sensitive areas.**

Monitoring physical processes

- Seven meteorological stations installed in the sub watershed.
- Seven water flow measurement sites.
- Training project personnel and local stakeholders.

Water quality monitoring

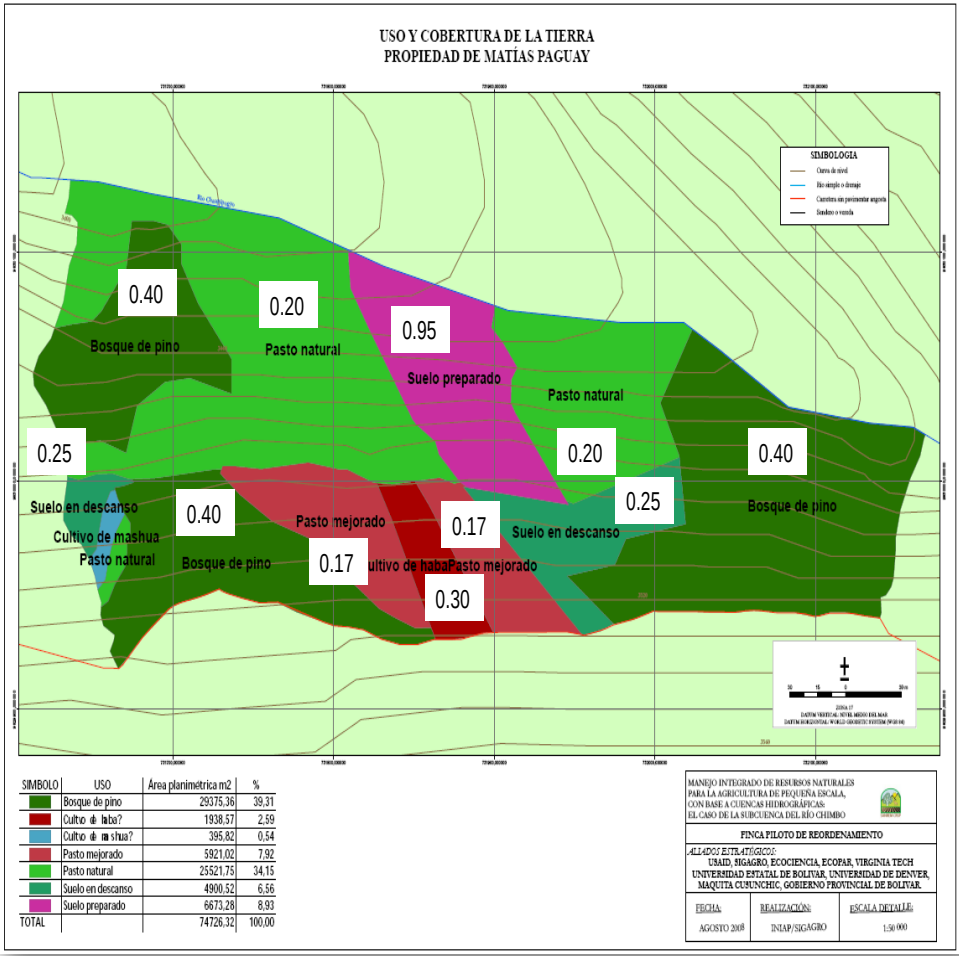


Biodiversity: trees and bushes

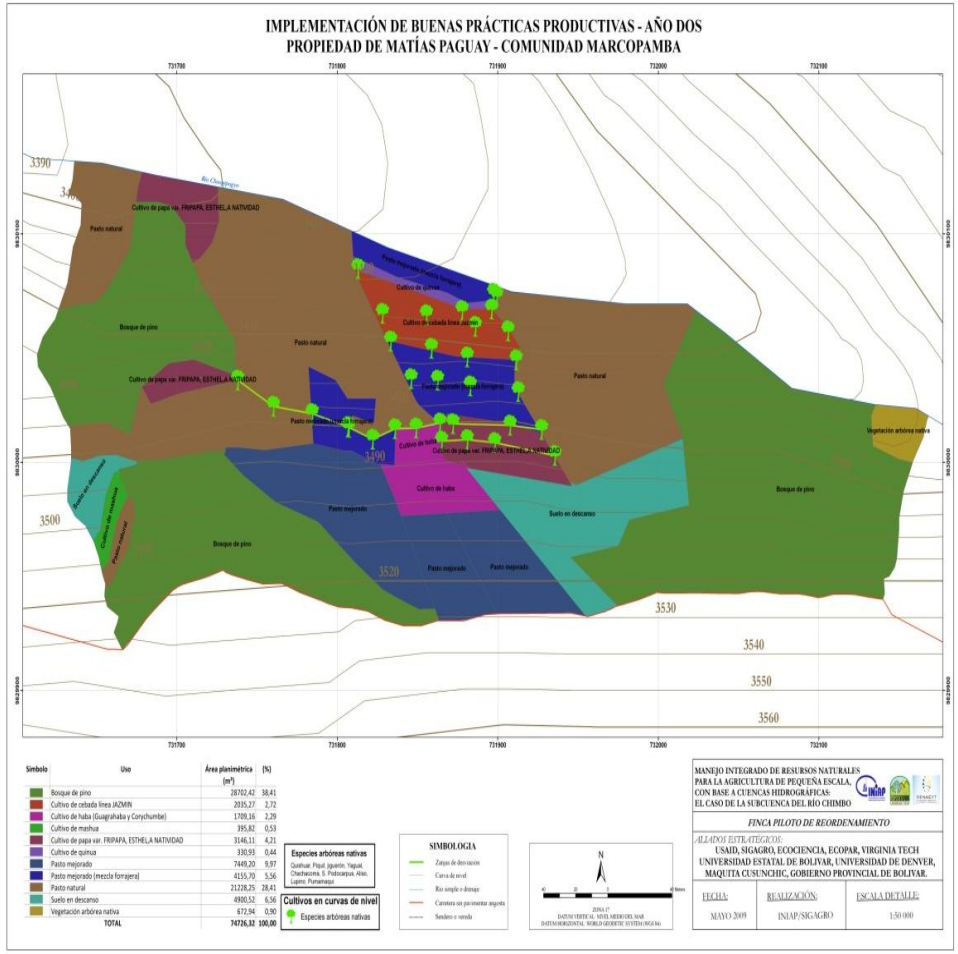
Parameters	Illangama	Alumbre
Total varieties (N)	53	151
Total families (N)	30	49
Total species (N)	47	118
Shannon index – Weaver H' (log_e)	3.94	4.87
Simpson´s index	31.78	110.08



BMP Implementation



SIMBOLO	USO	Área planimétrica m2	%
	Bosque de pino	29375,36	39,31
	Cultivo de haba?	1938,57	2,59
	Cultivo de mashua?	395,82	0,54
	Pasto mejorado	5921,02	7,92
	Pasto natural	25521,75	34,15
	Suelo en descanso	4900,52	6,56
	Suelo preparado	6673,28	8,93
TOTAL		74726,32	100,00



Símbolo	Uso	Área planimétrica (m²)	(%)
	Bosque de pino	28702,42	38,41
	Cultivo de cebada linea JAZMIN	2035,27	2,72
	Cultivo de haba (Guagrahaba y Corychumba)	1709,16	2,29
	Cultivo de mashua	395,82	0,53
	Cultivo de papa var. FRIPAPA, ESTHELA NATIVIDAD	3146,11	4,21
	Cultivo de quinua	330,93	0,44
	Pasto mejorado	7449,20	9,97
	Pasto mejorado (mezcla forrajera)	4155,70	5,56
	Pasto natural	21228,25	28,41
	Suelo en descanso	4900,52	6,56
	Vegetación arbórea nativa	672,94	0,90
	TOTAL	74726,32	100,00

Management alternatives

Improved pastures with deviation ditches

Management of improved pastures

Potato cultivation in contours

Reduced-tillage maize

Soil management alternatives

Strip cultivation

Deviation ditches

Native plants as live barriers

Contour planting

Farm-level results with and without BMP

Item	2006	2009
Land in crops (ha)	0.90	0.90
Land in potatoes (ha)	0.25	0.31
Land in natural grass (ha)	3.04	2.28
Land in improved pasture (ha)	0.59	1.35
Milk production (l/day)	33	51
Potato yields (t/ha)	10.80	16.20
Pesticide inputs ($/ha)	396	296
Net benefits ($/year)	1 021	1 378

Subwatershed-level results with and without BMP

Item	2006	2009
Food security		
Quinua	None	Pata de Venado
Barley	None	Shyri and Jazmin
Chocho	None	450 Andino
Faba beans	Genetic deterioration	I-440 e I-441
Natural resource management:		
Crop rotations	None	Crops-pasture
Strip cultivation	None	Pasture and crops
Deviation ditches	None	1372 linear m
Contour plowing	None	In crops
Protection of deviation ditches	None	Native species
Conservation tillage	None	In crops
Irrigation management	None	Broadcast irrigation
Protection of areas of water recharge	None	Native species


Investments and responsibilities of local, regional and national governments

Thank you! Questions?

Chimborazo Volcano