Landscape Modelling with Geographical Information System (GIS): a field application in Peru

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Introduction

- GIS
- Landscape

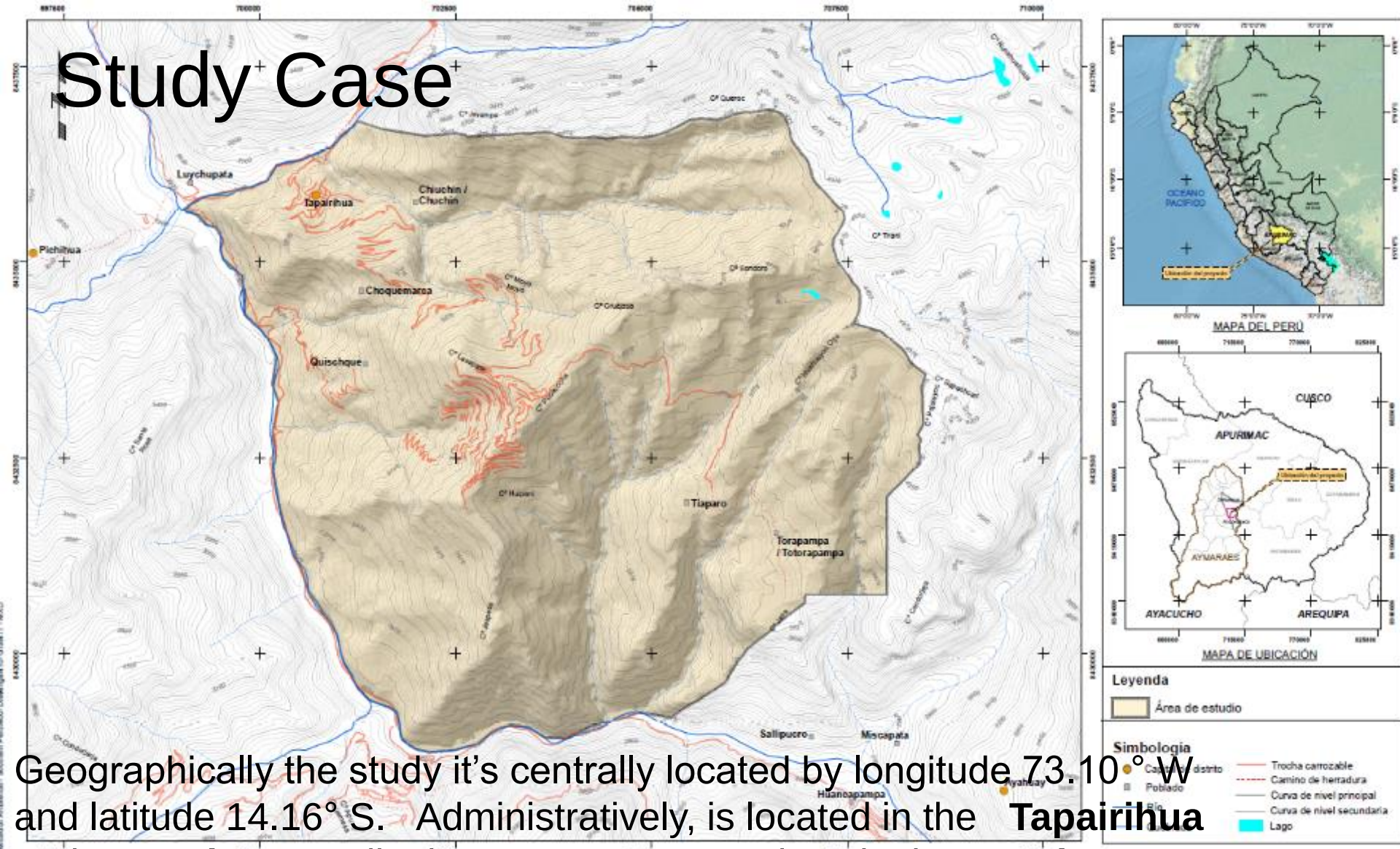
Landscape as the evaluation and analyst of a process that provides a consistent platform for spatial information for industry planning and application. Also, it can serve as a model to strategic investment in the region as bring engagement and commitment to investors. Likewise, it integrates several disciplines and improves decision making. Moreover, the patterns or results detected can be used to assess the impacts of past or future disturbance (natural or human) and to plan and regulate further human use.

Study area

To determine the Study Area for the landscape analysis, the specialist considered geographical, biological, social, and future human impacts.

(e.g. operation location during the mining exploration – drilling platforms, access, basecamp, etc).

Study Case



Geographically the study it's centrally located by longitude 73.10° W and latitude 14.16° S. Administratively, is located in the **Tapairihua** and **Poccohuanca** districts, **Aymaraes** province in the **Apurimac** Region (southern Peru).

Baseline studies (in Peru)

Conducted by

Archeologist

Human Geographers

Environmental Engineers

Biologist

Social Specialist

Geologist

Drafters

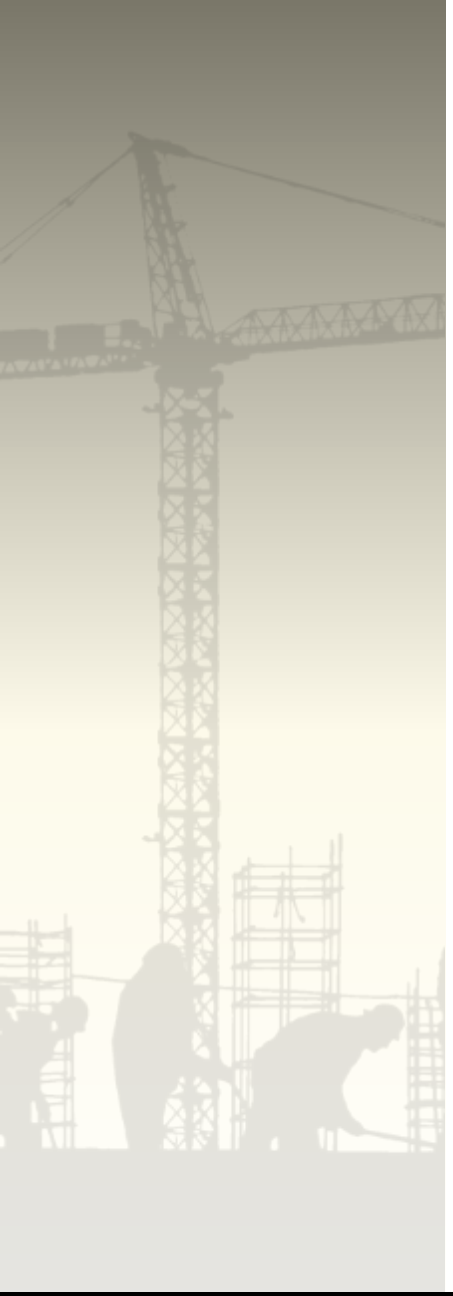
Chemist

Methodology

Quality analysis for Visual Landscape Evaluation involves assessing seven criteria: morphology, vegetation, color, water, scenic background, rarity and human performance. Assessment data were contrasted with field observation data.

For the Landscape Visual Quality (LVQ) analysis in the study area, geographic information systems (GIS) were used. The sources of information used in this analysis have been developed as part of the independent studies, as follow:

- Physiography,
- Slopes,
- Vegetation units,
- Local hydrology,
- Archaeological sites,
- Nearby communities
- Mine location and facilities.



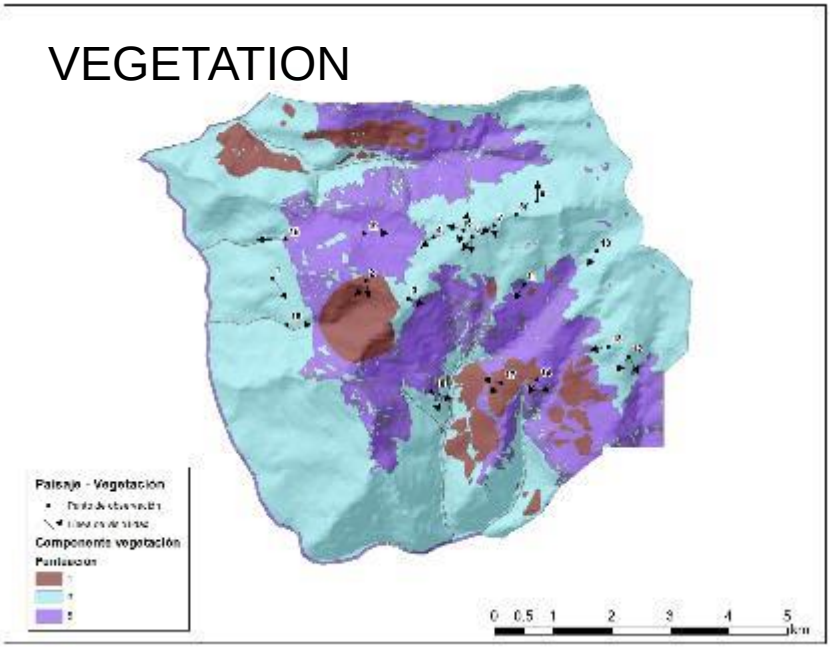
Evaluation of the Landscape Visual Quality (LVQ)

Field Observation Points (FOP)

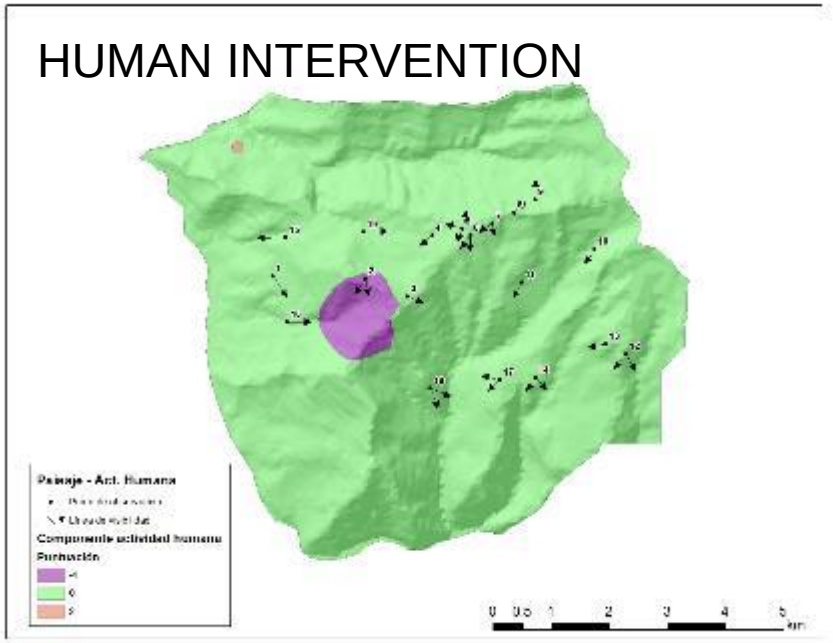
Evaluation Factors

Morphology	rocky formations); wide variety of surfaces or much eroded; dunes systems or presence of some very unique and dominant characteristics.	5
	Interesting erosive forms, sizes and/or shapes with/without varied relief. Presence of interesting shapes and details but nothing dominant or exceptional.	3
	Soft hills, flat valley bottoms, few or any unique details.	1
Vegetation	Great variety of vegetation types with interesting shapes, textures and distribution.	5
	Some variety in vegetation but only one or two types.	3
	Little if any variety or contrast in vegetation.	1
Water	Dominant factor in the landscape; clean and clear. Presence of rapids and waterfalls.	5
	Flow water or backwater, but not dominant in the landscape.	3
	Absence or presence invaluable.	0
Color	Combinations of intense and varied color or pleasing contrasts between soil, vegetation, rock and water. (from the field specialist point of view)	5
	Some variety and intensity of color and contrasts between soil, rock, vegetation; but does not act as a dominant element.	3
	Rarely any variation in colors or contrasts.	1
Scenic background	The surrounding landscape greatly enhances the visual quality.	5
	The surrounding landscape moderately increases the visual quality of the whole.	3
	The surrounding landscape has no influence on the visual quality of the whole.	0
Rareness	Unique or very rare in the region; real possibility of seeing exceptional wildlife or vegetation.	5
	The landscape is characteristic, although similar to others in the region.	3
	The landscape is common in the region.	1
Human intervention	Human actions or modifications which can affect negatively the visual quality.	2
	The scenic quality is slightly- or unaffected by disharmonious modifications.	0
	Intense and extensive modifications that reduce or nullify the scenic quality.	–4

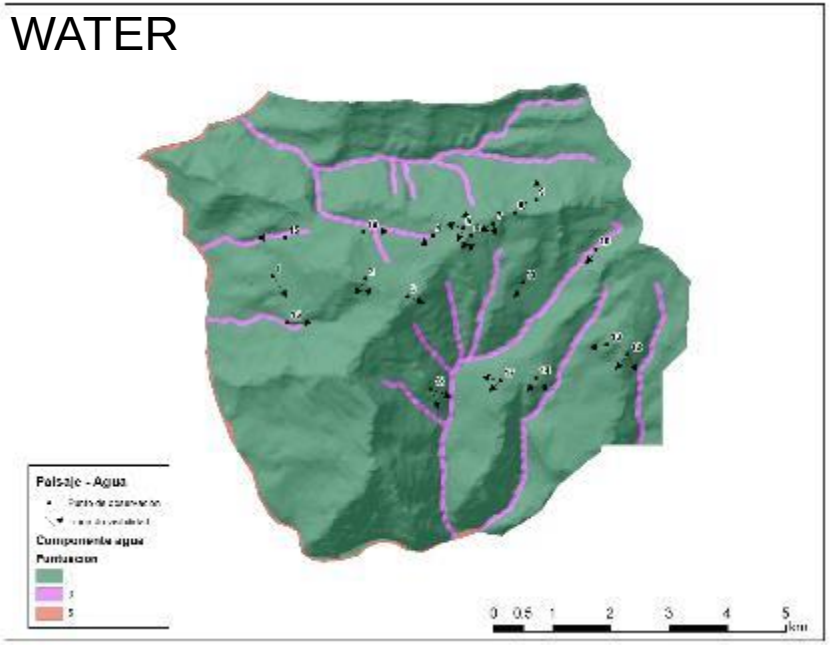
VEGETATION



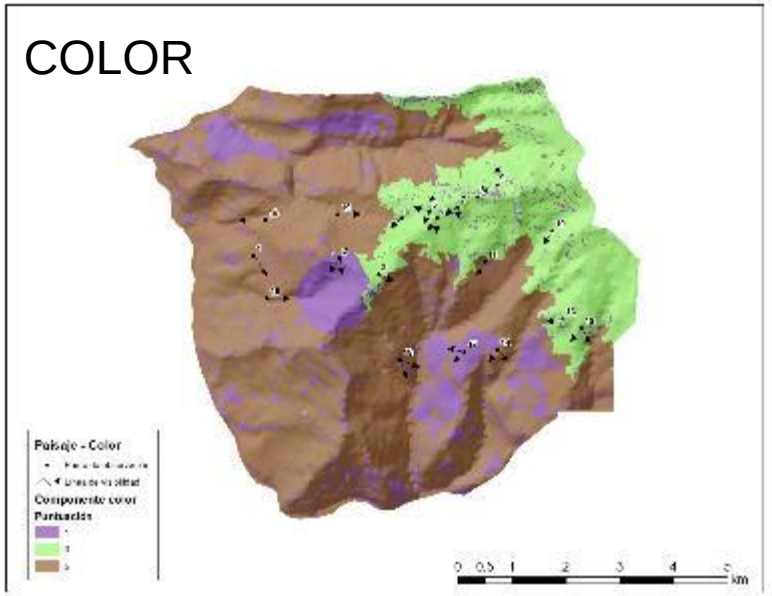
HUMAN INTERVENTION



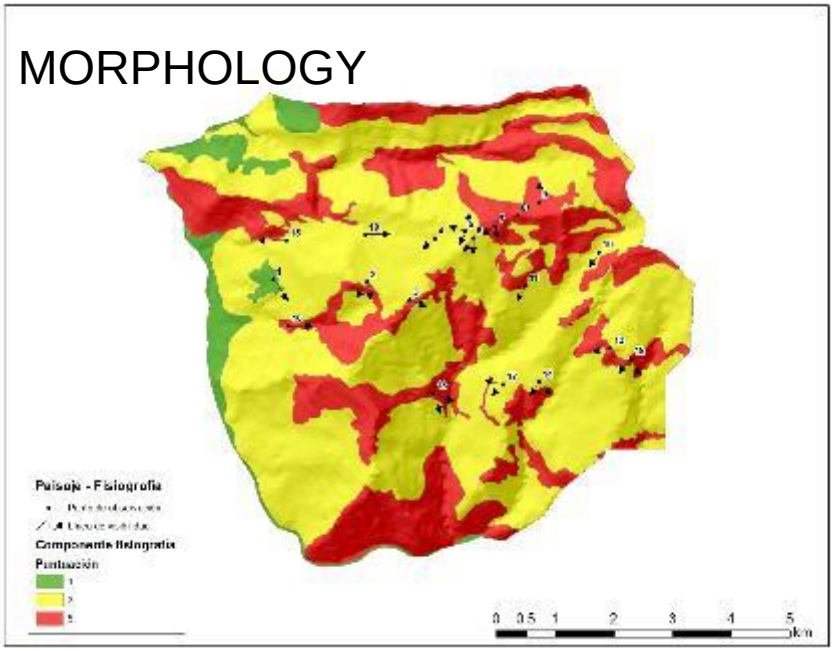
WATER



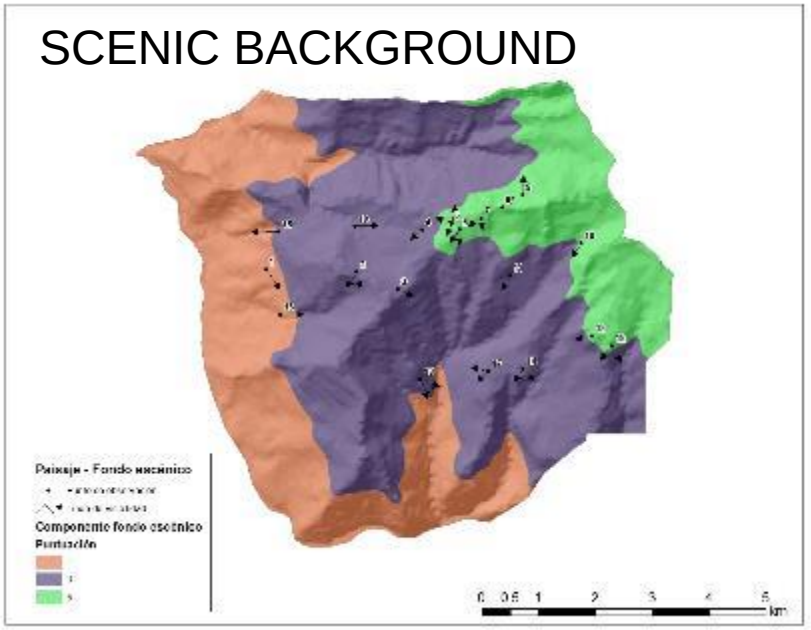
COLOR



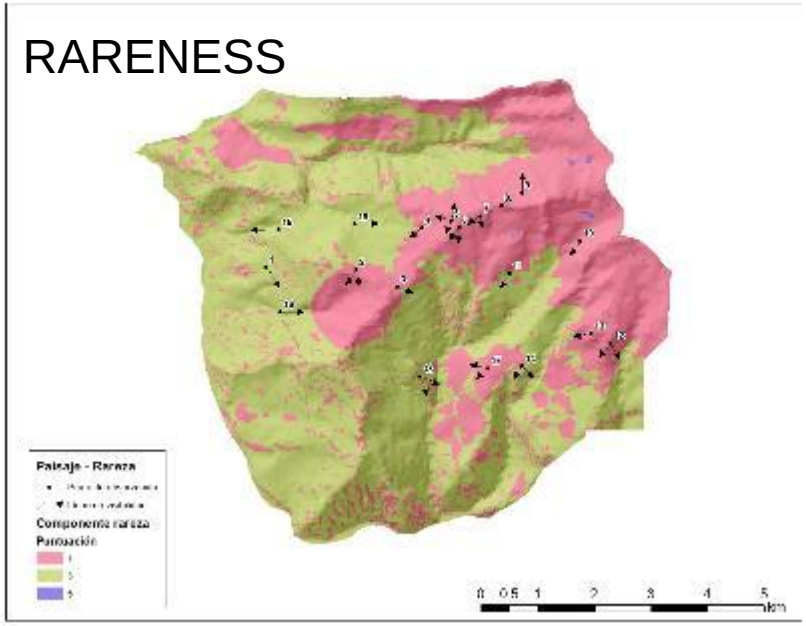
MORPHOLOGY



SCENIC BACKGROUND



RARENESS



Evaluation criteria for each of the LVQ factors

The LVQ model involved spatial analysis and 3D analysis, which were used to merge, model and unite the seven factors or layers contrast with the FOP.

The total sum of these factors determines the visual quality classification, according to the following table

Class	Description	Score range
III	Areas of high quality with unique and outstanding features.	19-33
II	Areas of average quality, whose characteristics have variety in form, color and line, but seem common in the study region and are not exceptional.	12-18
I	Areas of low quality, with little variety in shape, color, line and texture.	0-11

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Factor	Interpretation of valuation criteria	Score
Morphology	Areas with high elevations, undulating landscape, steep and rocky slopes.	5
	Areas with high or moderate elevations, soft undulating landscape, moderately steep slope and/or moderately stony.	3
	Areas with man-made modifications.	1
Vegetation	Scrubland, perennial forest and/or Andean wetland.	5
	Andean grassland, Puna grassland and rocky outcrops.	3
	Open spaces with little or no vegetation.	1
Water	Dominant factor in the landscape, clean and clear. rapids and waterfalls	5
	Water in motion or at rest but not dominant in the landscape.	3
	Absence or presence invaluable.	1
Color	Combinations of intense and varied color or pleasing contrasts between soil, vegetation, rock and water.	5
	Some variety and intensity of color and contrasts between soil, rock, vegetation, but does not act as a dominant element.	3
	Rarely variation of colors or contrasts, consistent color.	1
Scenic background	Scrubland or perennial forest.	5
	Andean grassland, Puna grassland, Andean wetland and/or rocky outcrops; open spaces with little or no vegetation.	3
	Artificial surfaces.	0
Rareness	Mostly unvaried scenic background.	5
	Perennial forest and Andean wetland.	3
	Scrubland, Andean grassland, Puna grassland and rocky outcrops.	0
Human intervention	Other areas.	2
	Archaeological sites.	0
	Population centers, agricultural areas, and/or areas without signs of human activities.	–4

Conclusions

Moderate impact - LVQ dominant Class II：

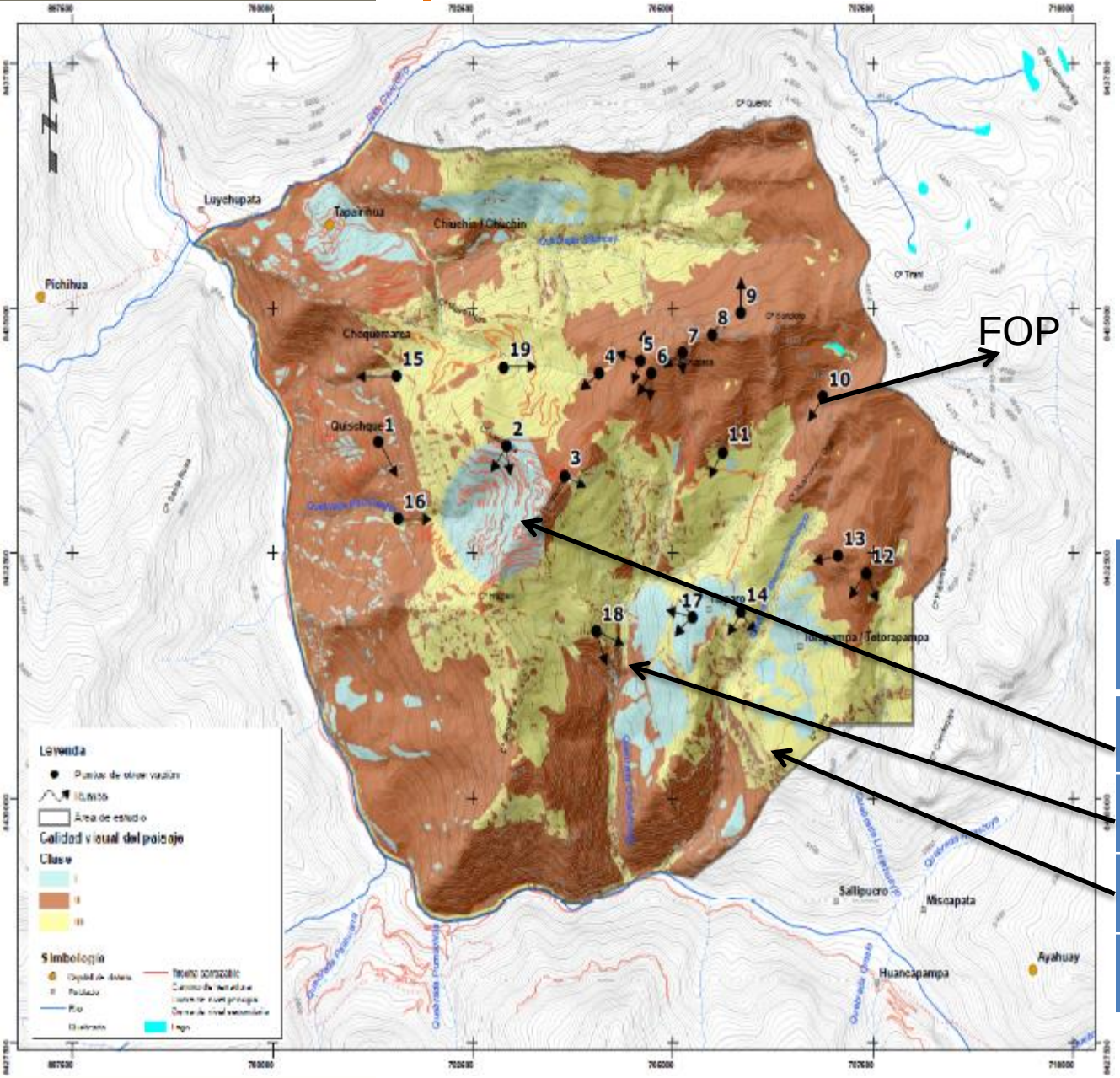
are distributed as patches and occupy the highest percentage (56.80%) within the study area. They are generally located on rolling hills and steep slopes, and they are characterized by a diverse and colorful vegetation, the presence of water, and the absence of human performance.

Low impact - LVQ (Class III): occupies 32.26% within the study area. They are distributed in the rolling peaks and slopes and are moderately steep; they have natural vegetation and some features of contrast without significant human performance.

High impact - LVQ (Class I): occupy 10.94% within study area. They are distributed on lower slopes and areas with wavy altitudinal elevation, which are the locations of the predominant population centers and grounds for agriculture.

The landscapes with low LVQ (occupying 10.94% of the study area) were found to correspond to areas where the morphology, vegetation and color have been modified by human performance.

Landscapes classes distribution



Landscape visual quality	Area	
	Hectares	%
Class I Severe	598.08	10.94
Class II Moderate	3105.96	56.80
Class III Low	1764.60	32.26
Total	5468.64	100.00

Thank you

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