

Supplementary Material

Table S1. Summary of the environmental, social, economic, and governance characteristics, as well as some historical facts of the municipality of Belmira [48].

Topic	Description
Environmental	<ul style="list-style-type: none"> Precipitation: 2,827mm per year 67.9% of the municipality's surface is covered by the strategic ecosystem of páramo (Belmira — Santa Inés Páramo). The water sources originating in the Belmira páramo supply water to approximately 68,000 inhabitants in 11 municipalities surrounding the páramo. 48.1% of the total municipal area is affected by land use conflicts due to over-use in inadequate livestock and agricultural activities. Provided ecosystem services include water regulation, biodiversity conservation, carbon storage, tourism, cultural and recreational services, among others.
Social	<ul style="list-style-type: none"> The estimated population in 2018 is nearly 6,000 people. The presence of six community councils in the settlements of Amoladora, Zafra, Montaña, Playas, Zancudito, and La Miel.
Economic	<ul style="list-style-type: none"> Trout production activities, dairy pasture, and potato farming. Additionally, <i>Pinus patula</i> forest plantations and hydrangeas. There are six active mining titles for the extraction of underground gold and silver minerals, alluvial gold extraction, and extraction of gravel, sand, and aggregates. The area dedicated to pastures covers 17,882.1 hectares, which is 59.9% of the municipal territory, of which 85.2% corresponds to pastures with some form of management, not necessarily improved varieties like <i>kikuyu</i>, ryegrass, or others such as Bermuda grass, “andadora,” and false poa, which are very common in the region. This management includes practices like paddock division, rotation, fertilization, weed control, etc. The remaining 14.77% consists of overgrown or mixed pastures with low stubble indicating less management or pasture abandonment.
Governance	<ul style="list-style-type: none"> Approximately 60% of the municipality is located within the Integrated Management District (DMI) for the Paramos and High Andean Forests of the Middle Northwestern Antioquia (SPBANMA) protection area. Most of the remaining part of the municipality serves as a buffer zone. Approximately 91% of the municipality is encompassed within the framework associated with the Watershed Management Plan (POMCA).
Historical	<ul style="list-style-type: none"> The territory was inhabited since the late 17th century by settlers in search of gold, which initially led to a transformation related to mining exploitation, and later, at the end of the 19th century, to livestock production, meat processing, potato cultivation, and subsistence farming.

Table S2. Variables used in the MCSA model. Variables like V04, although their use was not explicitly found as defined in this study, there are other studies that use variables measuring water importance. Regarding V06, the author performs an analysis of the importance of this variable but does not conduct a spatial study. As for V07, no study was found that relates it to the definition of restoration areas [57].

Variable	Criteria	Authors who have used the same variables	Related Factor	Related Disturbance
V01 — Land cover	Ecological	[30,50,54,74]	Stressor / Limiter / Enhancer	—
V02 — Erosion and mass movements	Ecological (Ecosystem services improvement)	[30,54,57,74,76]	Stressor / Limiter	Landslides
V03 — Flooding	Ecological (Ecosystem services improvement)	[57]	Stressor / Limiter	Flooding along the Chicó River and other drainage systems
V04 — Water importance	Ecological / Socioeconomic	—	Enhancer	Impact on supplying watersheds
V05 — Ecological connectivity (resistance + nodes)	Ecological	[30,50,57,76]	Enhancer	Loss of ecological connectivity
V06 — Properties with conservation processes	Socioeconomic (Territory context)	[75]	Enhancer	—
V07 — Properties with live fences	Socioeconomic (Territory context)	Own	Enhancer	—
V08 — Construction density	Socioeconomic (Territory context)	[30,50,74,76]	Stressor / Limiter / Enhancer	Agricultural expansion with monocultures (creole potato, tree tomato, cape gooseberry, avocado, among others)
V09 — Distance to forest loss	Ecological / Socioeconomic	[30,74]	Stressor / Limiter / Enhancer	Deforestation

In this study, to compare the different pairs of variables among themselves, the following question is posed: Which variable do you consider most important in defining suitable areas for landscape restoration? Each response is assigned a rating (according to Table S3). The values are then compiled into a comparison matrix for pairwise criteria to assess their importance relative to each other. Based on a series of statistical and mathematical analyses, the principal eigenvector is obtained, which establishes the weights (W_j) and, in turn, provides a quantitative measure of the consistency of value judgments among pairs of factors [56].

Table S3. Fundamental comparison scale for the assessment of elements. Source [55].

Value	Definition	Explanation
1	Equal importance	The importance of A and B is the same
3	Moderate importance	A is slightly more important than B
5	Large importance	A is significantly more important than B
7	Very large importance	A is much more important than B
9	Extreme importance	A is entirely more important than B
2 4 6 8		Intermediate values

Table S4. Proposed landscape restoration activities concerning changes in land cover between 2010–2020 in the study area. This relationship is assumed for the creation of the landscape restoration activity map, which is overlaid with the feasibility map of activities.

Landscape Restoration Activity	Land Cover Change
Preservation	Forest — Forest River — River Grasslands — Forest Transition — Forest Infrastructure — Forest River — Grasslands
Ecological Restoration	Transition — Transition Forest — Transition Grasslands — Transition Plantation — Transition
Sustainable Use	Grasslands — Grasslands Transition — Grasslands Forest — Grasslands Grasslands — Plantation Plantation — Grasslands Plantation — Plantation Transition — Plantation Infrastructure — Grasslands Forest — Plantation
No Activity	Infrastructure — Infrastructure Grasslands — Infrastructure Transition — Infrastructure Forest — Infrastructure

Table S5. Prioritization matrix for defining suitable areas for landscape restoration, according to AHP (Analytic Hierarchy Process). The values within the matrix represent the average of the importance ratings among variables, based on expert evaluations. The horizontal and vertical sum values are the product of matrix analysis. The priority vector displays the results of variable weights.

AGGREGATED MATRIX	V01—Land cover	V02—Erosion and landslides	V03—Flooding	V04—Water importance	V05—Ecological connectivity	V06—Properties with conservation processes	V07—Properties with live fences	V08—Density of constructions	V09—Distance to forest loss	Horizontal Sum	Vertical Sum	Priority Vector
V01—Land cover	1.00	0.75	3.38	0.28	0.41	6.21	3.21	8.14	1.15	24.5	10.1	0.17
V02—Erosion and landslides	1.33	1.00	6.11	1.55	1.40	6.43	3.74	7.24	3.00	31.8	4.2	0.22
V03—Flooding	0.30	0.16	1.00	0.64	0.71	3.16	1.93	2.63	0.79	11.3	15.9	0.08
V04—Water importance	3.55	0.64	1.55	1.00	2.41	4.83	6.43	5.81	2.54	28.8	4.8	0.20
V05—Ecological connectivity	2.46	0.71	1.40	0.41	1.00	4.83	5.52	6.21	1.00	23.6	7.5	0.16
V06—Properties with conservation processes	0.16	0.16	0.32	0.21	0.21	1.00	0.57	1.48	0.30	4.4	32.3	0.02
V07—Properties with live fences	0.31	0.27	0.52	0.16	0.18	1.75	1.00	0.80	0.49	5.5	25.7	0.04
V08—Density of constructions	0.12	0.14	0.38	0.17	0.16	0.68	1.25	1.00	0.49	4.4	35.3	0.03
V09—Distance to forest loss	0.87	0.33	1.27	0.39	1.00	3.38	2.04	2.04	1.00	12.3	10.8	0.08
	10.11	4.17	15.92	4.82	7.49	32.27	25.69	35.34	10.76	146.6	146.6	1.0

Table S6 shows that the most significant changes associated with the loss of natural land cover occur between the transition to pastures (89.18 ha, equivalent to 2.40% of the total area) and forests to pastures (33.22 ha, equivalent to 0.89% of the total area). Additionally, there is a gain from pastures to forests of 6.89 ha, equivalent to 0.18% of the total area, as well as from pastures to transition (5 ha, equivalent to 0.13%). Another important point is the change between pastures and forest plantations, which increased by 0.67% (25.10 ha).

Table S6. Land Cover Change Matrix between 2010–2020. It mainly highlights the forest losses, which amount to a total of approximately 43 ha. Compared to the transition to pastures, which amount to a total of 89 ha.

<i>Land Cover Change Matrix 2010–2020 (ha)</i>		Land Cover 2020						
		<i>Forest</i>	<i>Infrastructure</i>	<i>Pastures</i>	<i>Plantation</i>	<i>River</i>	<i>Transition</i>	<i>Total</i>
Land Cover 2010	<i>Forest</i>	561.30	1.10	<u>33.22</u>	0.40		10.07	606.09
	<i>Infrastructure</i>	0.02	108.19	0.93				109.14
	<i>Pastures</i>	<u>6.89</u>	7.42	2658.03	25.10		5.00	2702.45
	<i>Plantation</i>			10.45	2.93		0.18	13.56
	<i>River</i>			0.15		13.63		13.79
	<i>Transition</i>	4.12	4.47	<u>89.18</u>	1.76		164.26	263.79
	<i>Total</i>	572.33	121.18	2,791.96	30.19	13.63	179.52	3708.82

Table S7. Change in land cover classes between 2010 and 2020, with their respective landscape restoration activities assigned. Some of the values that show 0.00% are because there is an area, but its representation in percentage relative to the total area (ha) is very low.

Landscape restoration activity	Land cover class change 2010–2020 (%)	Area (ha)	Area (%)
Preservation	Forest — Forest (15.13%) River — River (0.37%) Pastures — Forest (0.19%) Transition — Forest (0.11%) Infrastructure — Forest (0.00%) River — Pastures (0.00%)	586.11	15.80%
Ecological restoration	Transition — Transition (4.43%) Forest — Transition (0.27%) Pastures — Transition (0.13%) Plantation — Transition (0.00%)	179.51	4.84%
Sustainable use	Pastures — Pastures (71.67%) Transition — Pastures (2.40%) Forest — Pastures (0.90%) Pastures — Plantation (0.68%) Plantation — Pastures (0.28%) Plantation — Plantation (0.08%)	2822	76.09%

Landscape restoration activity	Land cover class change 2010–2020 (%)	Area (ha)	Area (%)
	Transition — Plantation (0.05%) Infrastructure — Pastures (0.03%) Forest — Plantation (0.01%)		
No activity	Infrastructure — Infrastructure (2.92%) Pastures — Infrastructure (0.20%) Transition — Infrastructure (0.12%) Forest — Infrastructure (0.03%)	121.18	3.27%
		3708.8	100.00%

Table S8. Activities and feasibility assessment for landscape restoration within the study area. Approximately 4% of the area is considered to have medium to very high feasibility for ecological restoration. In terms of sustainable use, 55.7% of the area has medium to very high feasibility. Regarding preservation, the total value is 15.8% of the entire area, associated with areas of forests of high interest.

Activity	Feasibility	Area (ha)	Area (%)
Preservation (15.80%)	Very low	16.3	0.4%
	Low	71.4	1.9%
	Medium	103.6	2.8%
	High	194.9	5.3%
	Very high	199.8	5.4%
Ecological restoration (4.84%)	Very low	11.0	0.3%
	Low	24.5	0.7%
	Medium	59.1	1.6%
	High	52.3	1.4%
	Very high	32.6	0.9%
Sustainable use (76.09%)	Very low	337.7	9.1%
	Low	421.8	11.4%
	Medium	902.8	24.4%
	High	805.7	21.7%
	Very high	354.0	9.6%
No activity (infrastructure) (3.27%)	—	121.1	3.27%
		3708.8	100%

Table S9. Summary of the distribution of detailed and general landscape restoration activities in each of the properties evaluated through social cartography processes.

ID	Landscape restoration general activity	Landscape restoration specific activity	Specific activity area (ha)	Specific activity area (%)	General activity area (ha)	General activity area (%)	Total area (ha)
1	Preservation	Preservation of wetlands	0.33	0.05	2.38	37.1%	6,41
		Preservation of forests	2.05	0.32			
	Restoration	Enrichment with native and timber species	0.92	0.14	0.92	14.3%	
	Sustainable use	Trout farming	0.14	0.02	3.04	47.5%	
		Rotation of crops	0.07	0.01			
		Living fences + Sustainable livestock	2.83	0.44			
	Infrastructure	Infrastructure	0.07	0.01	0.07	1.1%	
2	Preservation	Nature tourism	1.82	0.10	6.16	32.8%	18,76
		Glamping initiative	0.03	0.00			
		Birdwatching	4.32	0.23			
	Restoration	Restoration in water sources and important water areas	0.98	0.05	1.13	6.0%	
		Restoration in current/old erosion areas	0.15	0.01			
	Sustainable use	Living fences	0.24	0.01	11.25	59.9%	
		Rotation of crops	0.02	0.00			
		Sustainable livestock	10.99	0.59			
	Infrastructure	Infrastructure	0.23	0.01	0.23	1.2%	
3	Preservation	Birdwatching	9.47	0.18	11.34	21.1%	53,74
		Preservation of forests	1.00	0.02			
		Preservation of water sources	0.88	0.02			
	Restoration	Restoration in water sources and important water areas	3.40	0.06	3.40	6.3%	
	Sustainable use	Living fences + Sustainable livestock	36.47	0.68	36.47	67.9%	
Infrastructure	Infrastructure	2.52	0.05	2.52	4.7%		
4	Preservation	Preservation of forests	1.82	0.12	2.90	18.6%	15,57
		Preservation of riparian forest relics	1.08	0.07			
	Restoration	Enrichment with secondary vegetation	0.17	0.01	0.38	2.5%	
		Restoration in water sources and important water areas	0.21	0.01			
	Sustainable use	Sustainable livestock	11.61	0.75	12.18	78.3%	
		Trout farming	0.30	0.02			

ID	Landscape restoration general activity	Landscape restoration specific activity	Specific activity area (ha)	Specific activity area (%)	General activity area (ha)	General activity area (%)	Total area (ha)
		Rotation of crops	0.27	0.02			
	Infrastructure	Infrastructure	0.11	0.01	0.11	0.7%	
5	Preservation	Preservation of riparian forest relics	0.06	0.01	2.00	25.2%	7,93
		Preservation of forests	1.94	0.24			
	Restoration	Restoration in water sources and important water areas	0.12	0.02	0.12	1.5%	
	Sustainable use	Sustainable livestock	5.55	0.70	5.55	69.9%	
	Infrastructure	Infrastructure	0.27	0.03	0.27	3.4%	
6	Preservation	Preservation of riparian forest relics	0.44	0.13	0.44	13.2%	3,33
	Sustainable use	Rotation of crops	0.16	0.05	2.65	79.5%	
		Sustainable livestock + Living fences	2.48	0.75			
	Infrastructure	Infrastructure	0.24	0.07	0.24	7.3%	
7	Preservation	Preservation of forests	5.13	0.18	5.13	18.5%	22,61
	Sustainable use	Sustainable livestock	22.23	0.80	22.23	80.2%	
	Infrastructure	Infrastructure	0.38	0.01	0.38	1.4%	
8	Preservation	Preservation of forests	0.48	0.13	0.48	12.8%	3,70
	Restoration	Restoration of riparian vegetation	0.18	0.05	0.18	4.8%	
	Sustainable use	Rotation of crops	0.07	0.02	2.65	71.6%	
		Sustainable Livestock + Living Fences	2.58	0.70			
	Infrastructure	Infrastructure	0.40	0.11	0.40	10.8%	
9	Preservation	Preservation of forests	10.90	0.13	11.26	13.0%	86,88
		Preservation of riparian forest relics	0.11	0.00			
		Preservation of wetlands	0.25	0.00			
	Restoration	Enrichment with native species	1.88	0.02	4.58	5.3%	
		Restoration of riparian vegetation	0.91	0.01			
		Restoration in water sources and important water areas	1.78	0.02			
	Sustainable use	Living fences	0.60	0.01	69.84	80.4%	
		Trout farming	0.05	0.00			
		Forest plantation	0.44	0.01			
		Sustainable Livestock	68.75	0.79			
Infrastructure	Infrastructure	1.19	0.01	1.19	1.4%		
10	Preservation	Preservation of forests	0.36	0.11	0.36	10.9%	3,33
	Restoration	Restoration of riparian vegetation	0.14	0.04	0.16	4.9%	

ID Prop- erty	Landscape restoration general activ- ity	Landscape restoration specific activity	Specific activity area (ha)	Specific activity area (%)	General activity area (ha)	Gen- eral ac- tivity area (%)	Total area (ha)
		Enrichment with native species	0.01	0.00			
		Restoration in water sources and im- portant water areas	0.01	0.00			
	Sustainable use	Avocado farming	2.03	0.61	2.51	65.8%	
		Rotation of crops	0.27	0.08			
		Sustainable livestock + living fences	0.22	0.07			
	Infrastructure	Infrastructure	0.29	0.09	0.29	8.7%	
11	Preservation	Preservation of water sources	0.84	0.33	0.84	33.1%	2,55
	Restoration	Restoration of riparian vegetation	0.02	0.01	0.02	0.8%	
	Sustainable use	Sustainable livestock	1.66	0.65	1.66	65.2%	
	Infrastructure	Infrastructure	0.02	0.01	0.02	0.9%	
12	Preservation	Preservation of forests	21.65	0.20	22.19	20.7%	107,45
		Preservation of wetlands	0.52	0.00			
		Preservation of water sources	0.02	0.00			
	Restoration	Restoration of riparian vegetation	0.05	0.00	2.55	2.4%	
		Enrichment with secondary vegetation	2.09	0.02			
		Restoration in water sources and im- portant water areas	0.42	0.00			
	Sustainable use	Sustainable livestock	76.46	0.71	79.72	74.2%	
		Crop rotation	0.33	0.00			
		Avocado farming	2.93	0.03			
	Infrastructure	Infrastructure	2.99	0.03	2.99	2.8%	
13	Preservation	Preservation of forests	0.74	0.01	2.82	0.9%	82,73
		Preservation of riparian forest relics	2.08	0.03			
	Sustainable use	Forest plantation	1.28	0.02	78.64	95.9%	
		Nature tourism	15.24	0.19			
		Sustainable livestock	61.37	0.75			
	Infrastructure	Infrastructure	1.27	0.02	1.27	1.6%	
14	Restoration	Restoration in current/old erosion ar- eas	0.09	0.02	0.09	2.0%	4,40
	Sustainable use	Sustainable livestock	4.20	0.95	4.20	95.5%	
	Infrastructure	Infrastructure	0.11	0.03	0.11	2.6%	
	Preservation		—	—	67.66	15.51	419.37

ID Prop- erty	Landscape restoration general activ- ity	Landscape restoration specific activity	Specific activity area (ha)	Specific activity area (%)	General activity area (ha)	Gen- eral ac- tivity area (%)	Total area (ha)
To- dos	Restoration				12.89	3.73	
	Sustainable use				329.39	78.54	
	Infrastructure				9.43	2.22	