

Review

Forest Transformation in the Wake of Colonization: The Quijos Andean Amazonian Flank, Past and Present

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Abstract: Forest transformation modified the Quijos' ancient mountainscapes in three ways: scientific approximation, entrepreneurial investing, and community engagement. We concentrate the study in the Cumandá Protected Forest reserve as exemplar in the Quijos valley. Our objective is to understand forest transition trends and prospects of sustainability by answering qualitative research questions of impact on cloud forest vegetation from a socioecological standpoint. We used ethnographic work, personal interviews, surveys to the community, and queries to authorities; our qualitative methods included critical discourse analyses, onomastic interpretation, and matrix comparison for ecological legacies, focused on three sectors of the economy that we posit impacted these forests, all indicative of a more competitive, globalized framework: forest tourism, retreating forest frontier, and mining forested watersheds. We found that these sectors also helped alleviate poverty in local communities so that ecotourism, non-traditional forest product harvest, and subsistence mining of water could become stewards, despite the fact that such a nuanced approach has not yet been fully implemented by local governments. We conclude that Hostería Cumandá promotes new conservation narratives in positive ways, since it fuels grassroots organizations to incorporate nature conservation into restoration ecology efforts, provides studies on mountain forest species of concern in the area, generates local employment, and converts a transitory, ephemeral attraction into an international tourism destination.

Keywords: forest frontier; biocultural heritage; cloud forests; montology; transformative change; farmscape; microrefugia; socioecological production landscape; forestscape; Andean flanks; Ecuador



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1. Introduction

With the changing demographics in mountain regions and increased pressures on resource exploitation to satisfy demands of growing cities in the lowlands, the forested areas of the tropical Andes experience worldwide stressors that are transforming community-driven, subsistence-based economies into a more global, urbanized, and industrial-based economy [1–3]. Human–environment interactions due to global climate change, and ensuing adaptation to economic and social transformations, make mountain communities vulnerable to external forces, while transformative ecological changes put resilience of time-tested cultures under pressure [3,4], which is often augmented when dealing with protected areas (PAs) and other forms of communal and private conservation easements in the equatorial Andes [5–7]. Biodiversity is often put under stress by these changes in two important dimensions, both affecting the complexities of mountain landscapes (mountainscapes henceforth), the permanent pressures of natural drivers, and the sporadic and ephemeral pulses in the behavior of the watershed [6,8]. These dynamics demonstrate forests as socio-ecological systems, showing Gestalt qualities such as transgressivity

and self-organization [7,8]. Thus, novel conservation and development practices are required, and modern approaches, such as protected biocultural heritage (PBH) [9] and socio-ecological production landscape (SEPL) [10], need to be considered when applied montology is implemented in the mountains of the world [10,11]. Our general research objective seeks to understand forest transformation driven by development pressures resulting from economic trends, including forest frontier expansion, agricultural pressure, and mining operations, as suggested in the roadmap for restoration research [12]. Specific objectives include elucidating the historical factors affecting conservation, understanding environmental change adaptations, and identifying successful community-driven responses to forest transformation. Thus, our research questions are threefold: What are the stressors that significantly affect the conservation of the cloud forest belt? How are the impacts of climate change contributing to a better adaptation for conservation? Up to what extent do community-driven initiatives for sustainability succeed in preventing forest loss and thus regenerating the forest frontier?

Among the many ways in which culturally-rich sites help protect biodiversity, the Andean region shows potential to become an exemplar for mountain forests elsewhere [13,14]. The PBH and the SEPL approaches appear to be successful in generating poverty alleviation options associated with ecotourism, non-traditional forest products, ethnobotany and ethnomedicine, and even help meet spiritual and nonmaterial needs [15,16]. However, this trend has received minimum attention from social scientists in the Americas, particularly in the Andes, where a dearth of research on the human dimension of global climate change exists [17,18]. Therefore, it is pertinent to emphasize resilience, adaptation for resource allocation, restoration, and the human drivers of landscape change as integer functions in the context of globalization and sustainability [18]. The realization of the SEPL approach, supported in social science research, should help in ending debates as to whether nature or culture is responsible for highland Andean ecosystems [11,17], and the new political ecology of conservation will include people as an integral element of PAs, particularly when dealing with indigenous people and traditional economic practices [6,19–21]. For example, during the last two decades, structural reform projects and capital investment in mountainous regions of the Ecuadorian Andes brought about a significant change in land use practices [22], away from the traditional, agriculturally based economy and towards a new industrial-based economy, one in which dairy farming and exotic cultivars (e.g., broccoli, asparagus) dominate [18,23]. In the pre-montane and cloud forest belts of the Quijos River valley of the Andean-Amazon flank of the tropical Andes (Tropandean landscapes henceforth), change has taken the form of pasture land, floriculture, as well as copper and gold mining, leaving the anthropic landscape fabric of the Quijos watershed surrounded by protected areas, showing an inversed Biosphere Reserve model, whereby the core area is the cityscape (i.e., Papallacta, Baeza, el Chaco), the buffer is the rural landscape (i.e., Cumandá protected forest), and the periphery is a wilderness of protected areas (i.e., Antisana Ecological Reserve, Cayambe-Coca Ecological Reserve and Sumaco-Napo Galeras National Park and Biosphere Reserve) (Figure 1).

These changes led to shifting from traditional rural landscape (farmscape henceforth), created over long periods by ancestral practices through generations of country folk, leaving an ecological legacy that is difficult to discern because of the heavy canopy of old growth forests that have recolonized the abandoned productive landscapes of antiquity [24,25]. These apparent pristine forests have shifted towards an exotic landscape dominated by aggressive patterns of timber and gold exploitation of extractive operations, a transformed rural landscape with new roads and increased traffic, the emergence of new cultural westernized values, and the neglect of tradition [19–21,25].

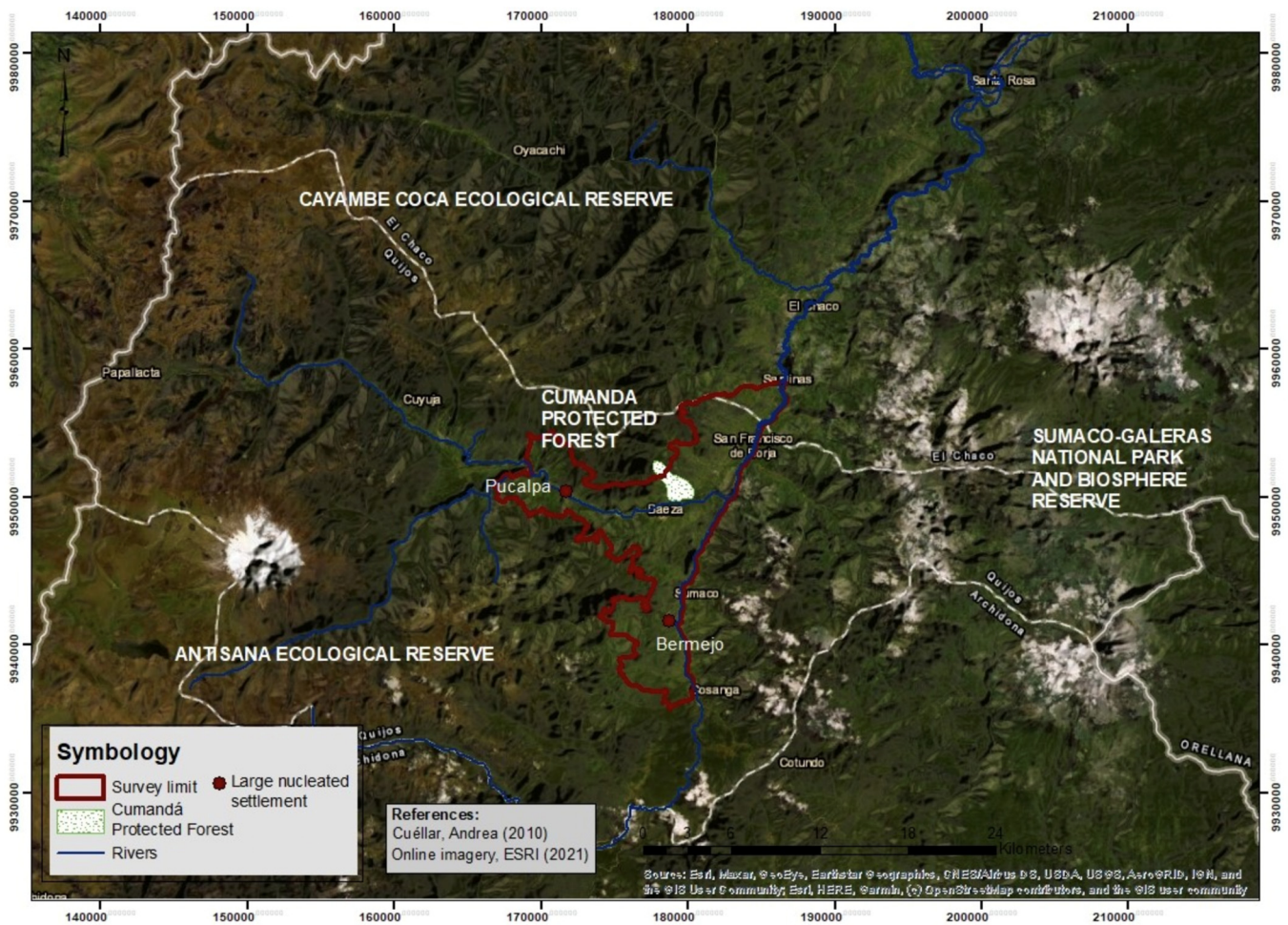


Figure 1. Map of the Quijos River basin, including the Antisana volcano, the protected areas of the national system, and the private reserve that helps contain the deforestation front of the Andean flank at the gateway to the Amazon River. Source: database Cuéllar (2010) and imagery ESRI (2021). Map elaboration by Ing. Paola Nicole Parra Curimilma.

The Andean Amazon flank has been studied for decades by biologists, yet the scientific knowledge is just now being compelled to integrate paleoecological insight, landscape archaeology, and current thinking [24–27]. The explosive richness of biodiversity there called the attention of early explorers and naturalists, who, reportedly, were impressed by the growing attention to neotropical diversity that could not be readily explained [26,27], such as the diversity found by the Antisana volcano and the eastern slopes in gradient to the Amazon [28–30]. There was such an impressive accumulation of tropical life that Humboldt’s profile of Chimborazo in the Western cordillera—his famous *Tableau physique* or *Naturgemälde*—included species that are found on Mount Antisana in the Eastern cordillera [31,32] and perpetuated the Humboldtian paradigm for altitudinal zonation [32–34]. The confluence of atmospheric rivers that come from Amazonia towards the steep slopes, where the easterly winds approach the cordillera, make the Upper Quijos River one of the wettest zones of the country, harboring a mossy forest shrouded in cloud almost all year long, and the plethora of wetlands, including lakes, lagoons, bogs, fens, and other waterlogged surfaces, create the motto for the area as a “natural sponge” [35,36]. Most common forest species are, among others, cedars (*Cedrela* spp., *Oreopanax* spp., *Schefflera* spp., *Gynoxis* spp., *Alnus acuminata*, *Buddleia incana*, *Weinmannia* spp., *Clusia octopetala*, *Vallea stipularis*, *Nectandra* spp., *Ocotea* spp., *Miconia* spp., *Siparuna* spp., *Myrica* spp., *Eugenia myrtelloides*, *Monnina* spp., *Podocarpus* spp., *Hesperomeles* spp., *Brugmansia* spp., even the national tree of Ecuador: *Cinchona officinalis*). Moreover, the epiphytic load of the

cloud forest canopy manages to be saturated with tank bromeliads, and hemi-parasitic bryophytes that intercept the mist to capture water which will be finally drained towards Amazonia [37,38]. So profuse is water capture, that the citizens of Quito use this hydric resource after transvasement of the eastern river flow westward, from the *Papallacta* area towards the capital city in the opposite site of the divide, towards the Pacific Ocean [39], often seeing it as a mining of water for consumption elsewhere.

The power of nature is manifested constantly, not only from torrential rains that overflow the riverbeds, causing havoc in downslope communities, but also from active volcanoes (i.e., Reventador, Sumaco), ice-capped mountains producing avalanches (i.e., Antisana and Cayambe), earthquakes, and frequent tremors that trigger rockslides and landslides (i.e., Guacamayas range) towards the alluvial cones that proliferate in the lowlands. Those are indicative of the young geology and dynamic geocological processes on fragile soils [40]. The magnitude of disasters has caused broken roads, inundated towns, and even forced the resettlement of the old town (i.e., “Baeza Viejo”) to a nearby hanging valley (i.e., “Baeza nuevo”). A recent example was given by the tallest waterfall of Ecuador, located at the lower end of the Quijos River, in the confluence with the Salado River to form the Coca River that flows towards the larger Napo River in the lowland Amazon region, The waterfall was severely affected by an earthquake and small eruptions of Mt. Reventador in February 2020. In an instant, more than 20 years of activism and resistance by local NGOs against the construction of a huge hydroelectric power plant (project Coca-Codo Sinclair) was swiftly muted due to a natural course change, because of the water channel implosion on the sidewall of the San Rafael waterfall. It was an iconic image; a favorite to depict in many publications as the paramount of tropical nature, which now no longer exists (Figure 2). As the waterfall disappeared, the riparian forests along the river channel also disappeared by receding erosion.



Figure 2. The San Rafael waterfall at the terminus of the Quijos river. (a) The left image is the historical flow and scenic beauty of the tallest waterfall in Ecuador. (b) The right image shows the change in the current flow that responded to natural causes of erosion; however, there are hints reflecting intensive manipulation of the riverine areas for the Coca-Codo Sinclair hydroelectric megaproject nearby. Source (a): Photo from Neotropical Montology Collaboratory, 16 December 2011. Source (b): Photo from Jack Rodríguez, 12 August 2021.

The Study Area

The Quijos river basin comprises almost the entire altitudinal gradient from lowland forest habitats to the highland forests towards the Andean divide. Ecotonal properties that are noted with increased elevation include an augmented forb layer, the diminishing heights of canopy trees, and the diminishing girth of tree and shrub boles. These forest habitats harbor most of the drainage basin and its biological richness [41]. Different elevation zones experience distinct climatic envelopes, reflecting a meteorological regime that is influenced by orographic and telescopic effects. On the slopes of the flank, adiabatic winds raise daily towards the ridges; but these are countered by descending katabatic winds, bringing humidity to the valleys at night. This effect encourages species that can capture

the abundant precipitation, leading to massive epiphytic gardens on the branches and exposed surfaces and waterlogging the soils [42]. Biologically, speciation is very active in this ridge-and-valley topography, where constant humidity produces cloudiness that enhances UV- β radiation, favoring mutation rate and stimulating speciation [25,42]. In Eastern Ecuador, there is one continuous cloud forest surrounding the city of Baeza. The high degree of biodiversity in the tropical montane cloud forest belt is impressive in almost every taxon [42,43]. A profusion of lauraceous trees with aroids, mosses, ferns, and orchids occurs mostly between 1800–2200 m, as an ecotonal height for the intermixing of both forest types, as predicted by Grubb's classification [29], who compared lower (700–1800 m) and upper (1800–3400 m) montane forests in Tropicandean landscapes, as an intermediate zone of mid-elevation forests has been identified [30], where *Cecropia* sp., *Ceroxylum alpinum* and *Dictyocaryum* sp. are conspicuous (Figure 3).



Figure 3. Panoramic view of the Quijos River at the mid-course level, near the town of Baeza at the Hostería Cumandá location, at the edge of Cumandá Protected Forest. (a) The left picture from 2010 shows the large isle that the white-waters course isolated in its rapid flow downslope. (b) In the picture on the right, taken in 2020, the isle is no longer visible in just one decade, due to human encroachment at the riverbank. Source (a) Photo from Jack Rodríguez, 15 September 2002. Source (b) Photo from Neotropical Montology Collaboratory, 6 July 2012.

This is the habitat for ‘cascarilla’ or ‘quina’ (*Cinchona officinalis*), the official national tree of Ecuador; other genera include *Clussia*, *Barnadesia*, *Oreopanax*, *Schefflera*, and *Weinmannia*. Tree ferns, especially *Trichipteris pilosissima* and *Cyathea poeppigii*, are found widely in these mountainscapes, along with conspicuous mountain bamboo (*Chusquea* sp.), which covers recently exposed landslides that often appear on steep topography [25,34]. These landslides occur not only because of tremors and earthquakes shaking the precipitous terrain, but also because of recently cut-off access roads and other mountain pathways, breaking the talus. Other important indicators of this montane habitat are palm species, especially those adapted to growth closer to the inclined ground (e.g., *Geonoma* sp., *Chamadorea* sp.). Because of the scarcity of flat lands, most plant species require root systems that resist gravity or ground-hugging stems, such as corms, bulbs, rhizomes, runners, stolons, tubers, and crowns [34,42]. Representative bird species include *Penelope montagnii*, *Crypturellus cinereus*, *Buthraupis montana*, and the big *Cephalopterus* sp., as well as the other iconic Cotingidae, including *Rupicola peruvianus aequatorialis*, considered the flagship of the rocky cliffs within the cloud forest [38,43,44]. Several endemic species have been described for the area, including the equatorial or crested quetzal *Pharomachrus antisianum*. Finally, the list of endangered species includes flagship mammals, such as the mountain tapir (*Tapirus pinchaque*), the Andean bear (*Tremarctus ornatus*), the equatorial cougar (*Puma concolor bamsi*), and the Andean tigrillo (*Leopardus pardalis*) [38].

The biodiversity of the site is even greater in the transition between the open pastures and the remnant forest areas. Cougars and bears, for instance, are often found near

cultivation plots or sites where cattle are reared. These forests contain much unique genetic material. For example, the “naranjilla” or *lulu* (*Solanum quitoense*) is vulnerable to infestation by nematodes in the monocultured soils of the open areas; however, wild stock of *Solanum*, which is genetically resistant to worms, can be found in the surrounding forests. Likewise, local tea is traditionally improved by the collection of Guayusa leaves (*Ilex guayusa*) in the forest nearby. Additionally, the presence of heirloom varieties of walnuts and some palms (e.g., *Juglans neotropica*, *Bactris gasipaes*, *Euterpe* sp., *Ceroxylum* sp.) encourages culturally sensitive forms of forest conservation [36,38].

The Quijos River drains the tertiary watersheds of the Cayambe and Antisana snow-packed volcanoes, flowing eastward to form the Coca River. This is the ancestral territory of the *Kofan* nation, who, along with the *Quixu* and “Canelos”, occupied the region before the *Inka* conquest, just before the Spanish colonization. The *Kofan* pledged dominion over an extensive territory recently recognized by the Ecuadorian government as their ancestral lands, with co-governance of the indigenous protected area extended the protection towards the other side of the mountains, including some important sacred natural sites [15] (pp. 3–10) and [42]. The mountain pass of *Wamani* in the continental divide, with its characteristic *Polylepis* woodlands, has been the preferred route to the Amazon from Quito since colonial times.

2. Materials and Methods

The Quijos River Basin has been subjected not only to land-use and land-cover change, but also to a significant forest transformation connected to both natural and human drivers in a dynamic socioecological production landscape (SEPL), where the Satoyama Initiative’s methodology of the Institute of Global Environmental Sustainability (IGES) of the United Nations University (UNU) fits quite well [45]. We selected a multi-methodological approach to study how interactions of the manufactured mountainscapes are evidenced after the post-Columbian indigenous depopulation registered in the area [46,47]. Archaeological findings pointed to the presence of people inhabiting the area at the time of contact, in the form of chiefdoms with strongholds that withstood the *Inka* presence towards the eastern Andean flanks [47], which was verified with paleoecological records from the area [48]. Historical and archival research verified when the conquistador Francisco de Orellana ventured through the Quijos River valley to discover the Amazon sea-river [24,26,36,48]; a great conduit was made obvious from the old *kulunku* system traversing the continental divide, which later allowed caravans of settlers from the highlands to follow the routes of *Yumbo* and *Canelo* nations (Castilian terms used to describe the people of the Quijos basin), with long lines of loaded mules. This practice is now recognized as a national intangible cultural heritage in the “Ruta de los Arrieros” conservation effort.

Our multi-method research approach incorporated deep-seeded knowledge of a native Baezan and scholarly concerns of long-cherished knowledge of the area [19,22,42,49,50]. In addition to the extensive and intensive literature review and archival research, we developed an ethnographic method by following the development of civil societies that have been created to pursue sustainable mountain development in the Quijos basin [51–54]. In addition, geographical research based on repetitive photography and expert interviews with key stakeholders’ photo-elicitation, as well as surveys for environment interpretation to visiting tourists, allowed better measures of the perception of environmental change in protected areas [55,56]. We also benefited from local student visits for field courses and study-abroad students related to tropical ecology, mountain livelihood, and environmental education campaigns. Several options have determined the transformative change in the forests, particularly around the town of Baeza, whereby, due to frontier-town idiosyncratic behavior, changes have established a conservation lifestyle based on ecosystem services, historical revalorization, private engagement in conservation, and multifunctional agropastoral management, all oriented toward the maintenance of the scenic beauty and the revaluing of historical and cultural elements that make these forests a biocultural heritage microrefugium of choice [55–58].

3. Results

3.1. Pre-Hispanic Settlements and Historicity

Archival research on the foundation of a mountain hamlet found that the Spanish name “Baeza” was borrowed from an isolated town perched in the faraway Cerros de Úbeda in Northern Andalucía, as if highlighting the long and difficult access for the Amazonian homestead respite in a valley that was, in the past, occupied by a large settlement of the *Cosanga-Panzaleo* culture [59,60], to justify bestowing royal status to “the most noble and most loyal city of Baeza de los Quixos”. Only two other Spanish colonial cities in Ecuador were founded with the royal seal: “the most noble and most loyal city of San Francisco de Quito”, in what was the seat of the *Kitu-Kara-Shyri* nation (and reportedly the “second Cuzco” for the *Inka* empire), and “the most noble and most loyal city of Santa Ana de los Cuatro Ríos de Cuenca”, in what was the seat of *Tumipampa* for the *Inka*, previously *Wapondeleg*, the land of the *Kañary* nation [61].

The timeline of the Quijos valley is shown in Figure 4, where the prominence of colonial explorations towards the Amazon rivalled those in the Colombian valleys and in the southern Ecuadorian mountain passes towards the Marañón River, as described by the French Geodesic Mission, who followed route maps of Salesian, Jesuits, Dominican, and Franciscan monks, who entered the Amazon with the first Spaniards. The fame of the *Wamani* pass became apparent when supplies of rich spices and tropical produce started flooding the vegetable markets of Quito residents, who soon appropriated the area of the “land of cinnamon” and claimed the “discovery” of the Amazon River to the world.



Figure 4. Timeline of the discovery and conservation efforts in the Quijos River valley in the Andean flank of the Ecuadorian Amazon, from prehistoric accounts to the historicity of the present, into the near future. Source: own design, 6 July 2021.

The Quijos forests attracted the attention of frontier settlers, who later developed a unique mountain town at the edge of the Amazon in colonial times [62]. The “Baeza viejo” was founded with the Spanish design of a central plaza and the square matrix, yet challenging topography often forced longer zigzagging access routes and hanging bridges to connect the lowlands and the highlands. This was, in essence, the nature of this important resting area for the voyagers of the past, whose caravans reached Baeza after weeks on the dangerous and often precipitous mountain roads for a change of “acémilas” or packhorses, giving preference to mules instead of horses or donkeys due to their enhanced ability to walk through slippery and muddy pathways and stone-layered shortcuts through the mountain forests [36,37]. No longer were llama caravans utilized, as in the pre-Columbian era along the mountain roads, because the huge weight of loads did not merit using them as beasts of burden. This movement of goods was facilitated later by the implementation of established resting places or “tambos” along the penetration road to Amazonia or “Oriente”,

which allowed safer travels with rest areas, fresh food provisions, and pack animals [63]. Ancient mountain routes (e.g., *kulunku*, *chakiñan*) facilitated trade between the lowland premontane jungles with the highland forests and Interandean valleys. Historical records confirmed that trade was exerted by traveling merchants or *Mindala*, who brought products from the jungle to the Interandean valleys and vice-versa, with the help of the people of the cloud forest areas or *Yumbos* [36,47,64]. Several routes have been identified, connecting the Quijos territory with indigenous settlements between *Pifo* and *Oyacachi*, in *Saurku* and *Kayampi*, further north to *Pimampiro* town and *Purwanta* Lake. This ancestral corridor was well known, thus serving as the gateway to the Amazon by early expeditions [52]. These routes (1) allowed entry to European conquistadors and other settlers to the Amazon in the XVI Century in search for the “land of cinnamon” and “El Dorado” [50]; (2) favored to implement colonial policies and the establishment of Spanish hamlets and villages [64]; and (3) continued the traditional flow of fruits, vegetables, skins, feathers and other valuables, including salt, between the highlands and the lowlands [42,65]. The importance of these trade routes was such, that the Spaniards implemented a fee payable to them for a permit to have muleteers’ caravans through the mountain forests, as well as for the right to stay in the rest areas along the perilous journey and little-known jungles [60].

Unlike traditional detection of archaeological sites—by asking locals about the presence of ruins to later document them [62], a systematic topographic prospection of 137.5 km² in the Quijos valley was made in 2002 to detect areas of human occupation [64], reconstructing patterns of pre-Hispanic settlements by calculating density concentration of surface pottery fragments. The study found seven human settlements in late pre-Hispanic epoch, for ca. a millennium (600–1538 CE), namely: three small non-nuclear—San José, Sardinias Chico and Santa Lucía del Bermejo—near the confluence of Quijos and Cosanga rivers; two medium-sized nuclear—Logmapampa and Sardinias Grande—to the north and west of the confluence; and, two large nuclear sites—Pucalpa and Bermejo [64]. The methodology for site reconstruction follows a basic premise: where the density of pottery pieces (artifacts) increases, the likelihood of greater human settlements increases because the larger middens reflect a larger population size [65]. More recent archaeological research in the Quijos forests points to the lack of geological processes severely affecting the landscape [66]. Only the 1987 earthquake, with its epicenter in Reventador volcano, marked a distinct topography with forestscape change. Mass movements and colluvial geodynamics were also frequent due to slopes’ clivage, with a median incline of 29.3% [66] towards the interfluvial forests. Thus, forest change is a constant factor due to tremors, episodic rainfall, landslides and other erosive forces [67]. However, no evidence of wild fire affecting forested watersheds has been identified. This change was also manifested in the construction of terraces for cultivation and housing [68]. It is important to depart from a suggestive interpretation of a stable pre-Hispanic past, with constant population growth conducive to the establishment of chiefdoms [64,69], solely based on documented fragments of artifacts disregarding their geodynamics.

A critical study of online sources, extensive use of one of our datasets, and comparative evaluation of digital elevation models [64,66,70] demonstrated that there is no correlation between site size and territorial use of site catchment size as factors to understand the pottery fragments on certain regions, considering slope/aspect in forest cover as a factor conditioning human mobility and access to forest resources [71] in highly dissected slopes characterized for micro-vertical succession on altitudinal vegetation belts [60,72]. Therefore, the Quijos’ forests are good examples to consider spatial factors, such as the visual dominance on trade routes with the highland Sierra or with the lowland Amazonia, that complement topographic and political criteria in our understanding of ancient human settlements in these forests.

The larger nuclear archaeological sites are located in the natural gateway towards the Quijos river, using the route from Papallacta to Baeza, and then to Bermejo to reach Puerto Napo in the lowlands. Pucalpa overlooks the headwaters of the Quijos when joining the Papallacta river at the mountain pass towards the highland Andean divide. Bermejo

overlooks the Cosanga river near to the Guacamayas range, a mountain pass to connect the piedmont of the Amazon. Cuéllar [64] determined early occupation of the area since the year 400 B.C. Therefore, we could affirm what Church [73] has identified as the driving force for the population of the montane forests of the Andean flank: visual control of forestscapes and trade routes. Amidst this impressive natural backdrop of the verdant, the human-dominated landscapes of the valley bottoms reflect an old tradition of forest frontier agriculture and livestock ranching. Therefore, long before its incorporation into the Western world, the Quijos river basin was much influenced by people [48,49].

A discursive analysis of population dynamics in this wide region showed that, despite the number of inhabitants (ca. 16,500–24,500) by the year 1577 [72] was from 2.4 to almost 3.6 times below the census figures for the year 2000, it is comparable to the present number of 17,268 people [28,58]. Therefore, it is important to observe current ethnographic data to understand the process of historical and ongoing cultural transformation. In 1561, the Spanish Viceroy Conde de Nieva defined the boundaries of the *Quiju* territories (Gobernación de Quijos) headed by Melchor Vázquez de Ávila, replacing Rodrigo Núñez de Bonilla and assigning to his tutelage the Spanish towns of Baeza, Avila, Archidona and Macas. This made *Quijos* the most important Amazonian region of the colonial era. It included various ethnic groups, such as *Yumbu* from the *Misawalli* river, *Sumaq* from the Suno river and Sumaco volcano, *Kuca* from the land of Coca (*Eritroxylon coca*) and the Coca river, *Uyakachi* from the highlands, *Santa* from the lowlands of the Salado river, *Kofan* from *Putumayu* river, “Pelones” (or encabellados) of the *Awariku* river, *Ankuter* and *Waorani* from *Curaray* river, and Orejones, Mazanes, and Iquitos from the lower Napo river, with their capital in the area of Baeza viejo [62–64]. The Quijos river itself was subdivided into three main areas: “Jatunquixos” to the highland western edge, “Coca” to the lowland northern collines, and “Cosanga” to the lowland southern piedmonts. The immensely complex and varied culture-nature hybrid of the forest created a kind of ‘mountain archipelago’ of land use mosaics in a tropical montane forest matrix, corresponding to different elevations in this mountainscape [26,39,42,51] (Figure 5).



Figure 5. The left picture (a) shows the settlers and explorers in the central plaza of the old town of Baeza in 1950. Note the bare terrain and the huts as housing. On the right (b), the new plaza in 2020 with distinctive benches, electric posts, many trees, manicured gardens, paved roads, and traffic on the side road. Source (a) from Jack Rodríguez, Mar 1952. Source (b) from Jack Rodríguez, 22 September 2021.

3.2. Forest Transformation Factors

Oral tradition and local surveys allowed us to grapple with the impressive change exerted by colonization and to assess the forest transformation from current activities,

making it clear that we needed to separate two types of factors: natural occurrences and human-induced changes. For instance, the earthquake of 1987 that altered the hydrography of the valley, or the disappearance of the most recognizable waterfall in Ecuador, “la cascada de San Rafael” in 2020; we observe the fate of these water features slowly, but because of a geological phenomenon, the speed of change was dramatic in February (Figure 2). Closer to the town of Baeza, in the mid-Quijos River, we can appreciate the change brought forth by humans and the need to send the water for one river channel, creating an artificial island now connected with the adjacent field on the Quijos riparian zone (Figure 3).

The establishment of local NGOs, such as the Cumandá Protected Forest, has served to facilitate an about-face of exploitation of resources in favor of a sustainable, regenerative use approach [65]. Moreover, the work done with Cumandá has allowed integration of otherwise unrecognized potential of agrotourism as part of the conservation toolbox in the area. The integration of women as key players of the development pathway is very appealing. For instance, Mrs. Doña Virgilia de Rodríguez, the first woman Undersecretary of Agriculture and President of the Chamber of Agriculture of the IV Zone of the Ecuadorian Amazon Region (RAE), hails from the Quijos Andean Amazon flank. This is only one example of note for the new generation of young women leaders, tourism students, and future professionals of conservation that will benefit the area conserved [65–67] (Figure 6).



Figure 6. Women have been present in formalizing and promoting conservation programs and other sustainable development ventures in the area. The left picture (a) shows the original wooden structures with thatch roof, while on the right (b) the houses are already brick with metal roofs. Source (a) from Jack Rodríguez, Mar 1952. Source (b) from Jack Rodríguez, May September 1988.

Today, this watershed continues to be a key transportation asset: from a *kulunku* (or a mountain footpath), to an *Inkañan* (or *Inka* road), to a muleteer track, to a gravel penetration road, finally replaced by a two-lane paved Interoceanic Highway [39,46] leading to the jungle loop (or “troncal de la selva”). Land exploitation during the ‘colono’ period greatly altered the original mountainscape into a mosaic of pasturelands, croplands, and remnant forest patches. Although the original *Quixu/Kofan* people have almost disappeared or migrated out of the area [47,53], rich archaeological evidence of their presence abounds in the area. Baeza, in the heart of the Quijos valley, is the only city towards the Ecuadorian Amazon territory that holds the rank of National Cultural Patrimony in Ecuador. Another important settlement, now considered one of the Ecuador’s Magic Towns, is “El Chaco”, in the lower Quijos river area. The lives of mestizo in the Quijos valley and *Kofan* original people in the Oyacachi River and around the Reventador volcano represent important samples of traditional and ancestral practices of alternative economic options in a working, living mountainscape, considered a socioecological productive system [15] (pp. 3–10) and [19,21,31,42].

4. Discussion

We consider that transformative changes to secure the conservation of the mountain forests of the Quijos River basin have occurred in phases, separated in three main periods with significant historical accounts: (1) the ancestral pre-*Inka* and pre-Hispanic epoch, with a significant population living in the piedmont occupation of the *Jatunquixos* area in the 1500s, starting the Colonial phase; (2) the republican epoch, in the following centuries, that used the area as a frontier zone, with exploitation fronts responding to the location of trade routes further amplified by gravel road construction; and (3) the modern epoch, with developments of the recent past since 1970 that brought the bigger road for the construction of the oil pipeline to cross the Andes and the declaration of the Cayambe-Coca Ecological Reserve and other protected areas to ensure maintenance of the most representative “wilderness” of the Andean flank. As in many ecological projects, defining the initial stage from which to restore the forest remains challenging [74]; thus, it is just as difficult to find the starting point of the transformation [61,69], the inflection points of the population pressure [75], or the “pristine” state to which to move ecological restoration activities in these forests [76]. Our work suggests using the metaphorical platitude “it depends” to establish conditions in assessing the environmental change afflicted in the Quijos River basin and its connected, transformed mountain forests [69].

One condition would be the biological richness of the area that seems to have mushroomed after the abandonment of the native population of the *Quixu* and the *Kofan*, first with the *Inka* expansion to the eastern cloud forest, then with the Spanish colonization of the Amazonian headwaters. If this trend is confirmed, monumental constructions are still waiting to be discovered under the dense cover of the cloud forest belt. A recent finding of inclined walls with megalithic design has just become apparent in the heart of *Llanganatis* National Park, south of the *Antisana* volcano and the Quijos River basin. Anecdotal accounts of stone terracing and other earthen works refer to the area of *Kuyuja*, near *Papallacta*, as a site of extensive terracing. The same structures seem to exist further north towards the “La Bonita” area in the headwaters of the *Putumayu* River. If all this evidence gets confirmed, then the area has to be incorporated within a new model of biocultural heritage of this ecological legacy, indicating that the cloud forest is actual a “feral” community that has settled again, with the ecological legacy of about four centuries of abandonment [28,42,49].

Another condition would be the political rhetoric, utilized to describe these new lands in a popular vision of the inaccessible frontier that prompted agricultural production, mineral extraction, or timber extraction exclusively. There was a famous quote attributed to the former president of Ecuador, Mr. Galo Plaza Lasso, saying, “The Oriente is a myth”, as a result of which, resources of the country went toward promoting economic development in the coastal and highland regions only, not the “wastelands” of the Amazon. There was little attention placed on long-term planning of agricultural production other than assigning land titles to the colonists that demonstrated ‘factual’ occupancy of the land. Therefore, the first thing a settler did was to clearcut the forest of a significant frontage, then to claim landownership of 50 hectares for the factual “evidence” of work done in the area. The National Institute for the Agrarian Reform (IERAC) was mainly charged with redistributing these “wastelands” and conferring the Title to those frontiersmen, which was later attributed to the Institute of Colonization of the Ecuadorian Amazon Region (INCRAE) and finally to the Ecological Development Institute (ECORAE), with funding from fiscal revenue generated by oil exploitation in lowland fields and usage of oil pipelines throughout, with dismal gains for conservation in the mountainscape.

Finally, a political ecology angle could be used to assess the transformative change in the Quijos forests, associated with the political agency of the local residents and indigenous communities [39], as other groups of the civil society saw the importance of switching gears in relation to maintaining the traditional agricultural practice of deforestation, planting crops, or pasture and placing cattle in the slopelands. Indeed, it seems that success in forest restoration of Amazon forests is site-specific [76]. Once the forest was gone, the planting

of crops was not profitable due to the low fertility and productivity of the mountain soils, pertinent precipitation—horizontal and otherwise, and the prevalence of nematode infestation. This was the case with the flagship cultivar of the area, the “naranjilla” or “lulo” (*Solanum quitoense*), which grew well only in recently felled “chakra” plots but diminished production after 2 years, where the nematodes infested the planted sites. The only way to continue with this revenue was to keep cutting down the forest and utilizing the fresh freed soil, every time for a new harvest. The presence of corporations exploiting the dairy industry brought economic respite by building milk-gathering facilities. It was only in the 1980s and 1990s that a move was energized to bring ecotourism (mostly as birdwatching and hiking) to the area, and several international projects took place, looking at what then was deemed as sustainable mountain development, which motivated forest conservation measures in smaller private reserves. For instance, the Sustainable Use of Biological Resources (SUBIR) project, funded by the US-AID, was key in turning the tide from traditional pasture or cultivation towards the use of forested patches and converting most of them into Private Reserves with ecotourism operations [72]. The creation of a network of reserves around the Quijos Valley confers an inverted Biosphere Reserve model, where pristine nature is located in the periphery of the settled area, making the nucleus or core the area, where most of the human impact is felt, the Sumaco-Napo Galeras National Park and Biosphere Reserve, close to the Cumandá Protected Forest to the East. The Antisana Ecological Reserve closes the area to the South and the Cayambe-Coca Ecological Reserve closes the area to the West and North. Connectivity among these protected areas remains key to the successes of the small private conservation areas (PCA), such as Cumandá Protected Forests, which are de-facto microrefugia of biocultural heritage and worth preserving.

A good example of this about-face in the exploitation of the forests towards a shift in the connectivity conservation of the mountain forests of the Quijos River basin was the establishment of the Cumandá Protected Forest as a private reserve near Baeza in 1993 [51]. This site maintains most of the forest protected, yet pressure from neighboring farms encroaches on its upper limits. Cumandá Reserve was highlighted by the rich diversity of useful plants and their medicinal and ornamental use; thus, it was incorporated as a member of the Latin American Ethnobotanical Sister Gardens Network in 1999, which later became a member of the Botanical Gardens Conservation International (BGCI) network in the Americas. An attractive rural setting was built in the place of the old farmhouse, where a hostel provides accommodation to visitors from Quito and other cities of Ecuador, as well as to an increasing number of foreign visitors. For example, at the “Hostería Cumandá”, we organized a scientific field visit for mountain scientists, who participated in the International Symposium of the Andean Mountains Association (AMA) on Sustainable Development of Fragile Ecosystems in 1998. An international group of scientists also met at Cumandá for the field trip of the Conservation Connectivity Network of IUCN-WCPA, which produced the *Papallacta Declaration* in 2006 and started emphasizing connectivity conservation as a goal of management of protected areas worldwide [69]. Several technical demonstrations and focused workshops were held with the residents of Baeza and the private sector in the last decade. Cumandá was also the site for the meeting of the Latin American Ethnobotanical Sister Gardens Network, which brought together Latin American colleagues and international experts in applied conservation with ethnobotanical insight to strategize on making Quijos a cultural landscape designation within IUCN category V [23].

5. Conclusions

We conclude that the stressors affecting conservation of the cloud forest belt are identified roughly with the practice of extractivism, operating since colonial times. Particular stress was provided by the federal incentive to grant land ownership by titling those parcels that demonstrated active deforestation. Another important stressor for the change is the subsidies given to dairy production and the fever of the “white gold” that pushes the establishment of large expanses of planted pastures with improved varieties of invasive grass

species. These two stressors were facilitated by the road construction of the Interoceanic Highway through the area that exacerbated the opening of the frontier and the degradation of the forested slopes [66].

We concluded that impacts of climate change contributing to a better adaptation for conservation are the establishment of private forest reserves, the operation of ecotourism companies offering non-traditional practices, such as white-water rafting and rappelling tours. The increased presence of foreign visitors has prompted an urban “renaissance”, making Baeza an internal tourism destination for cultural and natural features.

We concluded that community-driven initiatives for sustainability succeeded in preventing forest lost, as well as in regenerating the forest frontier because of the implementation of nation-wide initiatives such as “Plan Bosque”, which compensated landowners for not deforesting the remnant forest patches of the basin, making a successful exemplar of payment for ecosystem services (PES) an attractive income, particularly when the PES for the water captured in the basin and transvasing towards Quito became a *modus operandi* for funding conservation of the headwaters. Finally, the establishment of private forest reserves has proven successful. For instance, Cumandá has now integrated not only ethnobotanical applications, but also ecotourism and recreational activities, such as weekend workshops of different conservation topics or hosting kayaking groups for navigating the rapids of the Quijos River, considered one of the best places for white-water rafting in the world. This link, with abundant water resources and the scenic beauty of the river, led to the establishment of the “Route of Water Commonwealth” in 2017, which includes the local decentralized governments (GADs) and municipalities along the Quijos River, and made this location into an officially declared priority area for sustainable mountain development initiatives and biodiversity conservation [20]. Furthermore, the transformative change that Cumandá promoted was the new approach of biocultural diversity and heritage by fomenting territorial planning that integrates the human dimension with nature conservation, applied in the buffer area of one of the most diverse biosphere reserves in the world. Cumandá Protected Forest and Hostería was key in helping to establish Baeza as a “National Heritage City” of Ecuador in 1994. It also played a key role in establishing the intangible heritage of the “Itinerary of the Muleteer” in 2018 and incorporating it within the National System of Intangible Heritage, highlighting the montane forest belt as a “cultural landscape” that is worth protecting. It is hoped that this momentum continues with the incorporation of the Quijos River basin as a Satoyama site to demonstrate that the benefits of harmony between nature and people could lead to sustainable, regenerative development.

With the case of Cumandá Protected Forest, we analyzed the efficacy of adapting to environmental changes in the Quijos River Valley on the Andean Amazon flank, with the prospective of tropical montane forest conservation scenarios [77]. We highlighted the difficulty to establish a starting point in farmscape transformation, as it is difficult to mark the beginning of restoration ecology programs without knowing where to start to target forest restoration efforts, since human occupation has long been recorded in paleoecological and archaeological research. This is the important challenge for future research and application of the Satoyama landscape approach for mountainscapes. Since they are Socio-Ecological Production landscapes (SEPL), there is a need to highlight the importance of equilibrium between exploitation and wise use of forest resources, allowing for the inclusion of alternative forms, such as agrotourism, ethnotourism, ecotourism, and adventure tourism in the mix of choices for local empowerment with Non-Timber Forest Products (NTFP) and private reserves as part of “other effective conservation measures” (OECMs). For instance, making the watershed a GeoPark will highlight the nature-culture linkages of these impressive mountainscape. Additionally, declaring it as a Globally Important Agricultural Heritage System (GIAHS) will highlight its rich biocultural diversity. This gamut of options should reflect the gains observed with the integration of women in the political ecology of biocultural heritage conservation, and it should promote higher levels of educational attainment and leadership engagement of women in the local civil society.

Finally, we argue that further research is needed to understand the imperative of switching the current conservation narrative, emphasizing forest biodiversity for “sustainable” development. New research efforts should engage in formulating “regenerative” development to allow for forest restoration of self-correction and self-organization processes that ameliorate forest conditions and create a mountainscape, with respect for the surrounding forestscape, which could be maintained for perpetuity.

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