

Article

Socioecological Dynamics and Forest-Dependent Communities' Wellbeing: The Case of Yasuní National Park, Ecuador

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Abstract: Protected areas are considered the backbone of biodiversity conservation, but their management often fails because local people are not involved, and their needs are ignored. A socioecological approach has been demonstrated to be effective in improving the relationship between conservation efforts and human wellbeing through a better understanding of the interdependence between nature and people. This relationship can be observed through the case of the Kichwa indigenous communities within Yasuní National Park, Ecuador, as they have retained a very close relationship with forest ecosystems. Using key respondent interviews, along with semi-structured interviews and focus groups, this research describes the complex relationship between changing forest ecosystems and human wellbeing. The results highlight food, health, and cultural identity as the most important benefits that communities obtain from forests. The research also sheds light on how people in the investigated area perceive the dynamics of socioecological systems, indicating petroleum, infrastructure development, and small-scale agriculture as the most important direct drivers and land governance and the presence of colonists as the most important indirect drivers of changes to forest ecosystems. This paper demonstrates the importance of monitoring socioecological systems and adapting management to balance complex economic, social, and ecological challenges.

Keywords: Yasuní National Park; socioecological systems; protected areas; indigenous communities; ecosystem services; local community benefits; forest dependency



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1. Introduction

The management of protected areas (PAs) is a worldwide concern [1], as they are considered essential for biodiversity conservation [2,3]. About 16% of the Earth's surface is in PAs [4]. Thus, the establishment of PAs remains the main strategy against the accelerated decline and loss of biodiversity [5–7]. In addition, PAs are mechanisms to sustain ecosystem services (ESs) [8] and ensure the persistence of the natural and cultural heritage they contain, constituting an important element for the survival of populations and poverty reduction [9,10]. However, PAs are complex systems, and they face great challenges [11]. Conservation areas based only on current ES flows may not account for the changing contribution of ESs to human wellbeing [12], which is why there is a significant interest in studying PAs as socioecological systems [13–15].

In many cases, PA conservation strategies assume ecosystem immobility [16]; their management schemes often generate conflicts because benefits for local people are not realized and their participation is neglected [13,17]. In this sense, a socioecological approach

is needed, with integrated management that contributes to the conservation of natural resources and human wellbeing, assuming that human beings, their diversity, and their cultural practices are part of the natural systems, creating a system of interdependence [18]. This, in turn, requires units of analysis that must be evaluated and managed from an ecological and socioeconomic point of view [18].

Almost all PAs have human settlements in contact with wildlife and ecosystems [19], being subject to various positive and negative pressures, such as population growth and land use intensification [19]. Better understanding these pressures supports adaptive management grounded on self-organizing systems that allow comprehensive and transformative changes at the economic, social, and ecological levels, based on continuous feedback and learning from interactions [20].

In the case of Latin America and Ecuador, socioecological interactions are fundamental for developing communities due to the interdependence between nature and people [21]. In Ecuador, oil exploitation, timber exploitation, monoculture agricultural expansion, and, in recent years, mining, have contributed to a loss and degradation of biodiversity and have generated socioenvironmental conflicts and impacts [21]. Consequently, the management of PAs should benefit from a socioecological understanding that integrates the ancestral knowledge, culture, uses, and benefits of biodiversity to understand and improve management practices through solutions based on adaptive management that respond to the reality of the territory and not the implementation of global management systems, which do not guarantee efficiency in tropical humid ecosystems [9].

The present study focuses on YNP and the Kichwa indigenous people as a typical example of the complexity of socioecological system analysis and the use of resources in connection with local indigenous populations [22]. The Kichwa community is seen as the largest and the most active indigenous community related to YNP [22]; its long and intimate relationship with forest ESs provides a very meaningful case study for the debate on PAs and local communities. This study belongs to an array of studies focusing on the implementation of the adaptive management of vulnerability and risk at conservation sites (MARISCO) methodology [23] in order to support the adaptive management of YNP; the initial results reveal a risk assessment and stakeholders' identification and description [24]. This paper complements the previously published results from the aforementioned array of studies [24] by aiming to identify and describe the dynamic of the relationships between the wellbeing of local communities and the forest ecosystems, as well as the drivers influencing this dynamic over time.

The research questions that guided this research were intended to address the studied case (the Kichwa community in YNP) and to be relevant to broader debates on PAs and local communities: (1) What are the benefits for the local communities of the forest ecosystems within the PA? (2) What are the drivers influencing the forest ecosystem dynamics and the local communities' wellbeing?

2. Materials and Methods

2.1. Study Area

The study area is located in the Ecuadorian Amazon region, in and around YNP (Figure 1). Situated in the northeast part of the Ecuadorian Amazon, YNP (including the Tagaeri-Taromenane Intangible Zone), together with Waorani Ethnic Reserve, forms the UNESCO Yasuní Biosphere Reserve. Described by numerous sources as being the most diverse place on the planet [25–27] due to the richness of plant, amphibian, bird, and mammal species [26]. Yasuní National Park (YNP) is one of the best-known PAs in Ecuador, with immense biodiversity benefiting from its position at the intersection of the Amazon, the Andes, and the equator [28]. Within the YNP, there are 16 indigenous communities (eight Kichwa and eight Waorani) and the voluntarily isolated Tagaeri and Taromenane native people with a historical presence in the area, a unique mixture of indigenous populations. The area hosts around 45,000 people who are members of indigenous local groups, including the Waorani ethnic group living in the area surrounded by the territory of the

YNP—a relatively newly contacted group [29] that carries out continuous, sometimes violent, attempts to protect its territories [30]. In the strictly protected area of YNP, there is a self-isolated part of the Waorani group [31], the Tagaeri-Taromenane, with a population estimated at 300 individuals [26]. Other indigenous ethnic groups, located mainly in the buffer zone, are the Kichwa and Shuar. The Kichwa communities constitute a fundamental actor in the conservation and management of the PA: Añangu, Indillama, Nueva Providencia, Pompeya, San Roque, Sani Isla, Llanchama, and Mandaripanga [32]. The Waorani nationalities and the Amazonian indigenous people have had a historical presence in the area; the Kichwa nationality has recently been constituted and recognized as ancestral by the Inter-American Court of Human Rights [33]. There are also nonindigenous settlers' communities who have arrived in the Orellana province since the 1970s with the opening of roads for oil exploration and exploitation [32], often accompanied by mestizos—people of mixed ancestry with a white European and indigenous background.

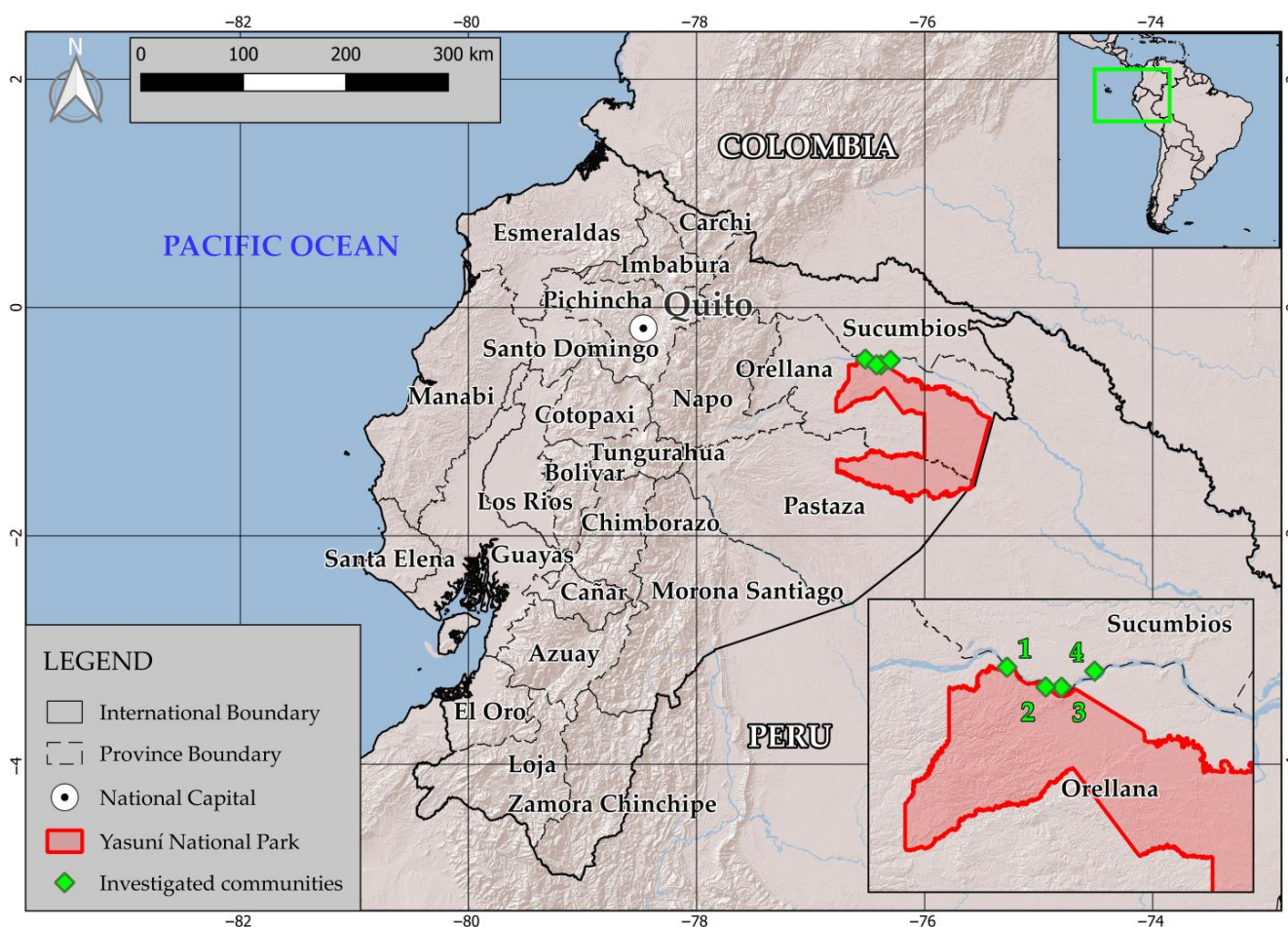


Figure 1. Study area—location of the investigated communities (1: Indillama; 2: El Pilche; 3: Añangu; and 4: Sani Isla).

The Kichwa community has the most inhabitants in the buffer zone, constituting a fundamental actor in the management of YNP [34]. Most people work in agriculture and housekeeping; few provide services in public or private organizations [34]. The migration of some families and individuals occurs, especially to the city of El Coca, for work or studies. Agriculture is their main economic activity. They practice subsistence and commercial agriculture. The products mainly sold are cassava, banana, corn, cocoa, coffee, and rice. These products are sold in nearby cities. Tourism is another economic activity that they

have carried out [34] with considerable success in the past decade [35,36]. Tourism has a positive impact on the socioeconomic growth of the community [37].

This combination of high biodiversity and rainforest indigenous people is found in a zone with huge economic and strategic importance for Ecuador: under YNP, there are Ecuador's second-largest oil fields, upon which Ecuador highly relies [28]. At the same time, YNP attracts illegal logging, as well as other illegal activities that affect the rich forest ecosystems through their actions [38]. In this very complex environment, the decision in 2013 to exploit some territories within YNP for oil led to social and territorial conflicts with various participants: the government, environmental collectives, NGOs, and indigenous communities [39]. Despite increasing concern about adopting participatory approaches, the current management of YNP does not fully integrate the social principles of resilience (adaptive thinking, learning, participation, and governance) or social factors (poverty, a lack of education, and population growth), which deepens conservation conflicts [24,40]. There is room for better integration of the human factor and the local, formal, and informal institutions in management in an articulated manner [21].

The study area has been the subject of numerous studies regarding the relationship between local communities and economic pressure challenging conservation efforts [28,41,42]. Studies on forest ecosystems related to the determinants of local community wellbeing [43,44] have mirrored the cultural richness of local ethnic groups [44], forest ecosystems' dependency [43], and land cover changes [45]. Socioecological challenges related to the Kichwa community and its environmental management strategies have been identified, and solutions have been investigated in the areas of the inefficient use of water resources, poor land use management, and a lack of inputs or resources [46], as well as tourism [35]. However, there are still significant knowledge gaps in the description of the complex dynamic that defines ES–human wellbeing relationships and the drivers behind this relationship. Understanding these drivers and dynamics is essential to find the best equilibrium in the socioecological system.

2.2. Data Collection

This research used primary data from interviews and focus groups carried out in the field and secondary data collected through bibliographic research. Secondary data collection was carried out based on a systematic review of the following materials: the scientific literature; the gray literature, such as reports, notes, maps, photographs, and various studies with a socioecological or environmental focus; and information on forest ESs in YNP, including types [42,47–49], dynamics, and associated risks, from both environmental [42,50] and social perspectives [24,42,43,51].

Field research was conducted in June 2022 for a period of 10 days using a combination of semi-structured household interviews, key respondent interviews, and focus groups. Based on the spatial dynamic of the identified risks, areas that were characterized by high vulnerability were selected [24], and the communities in these areas were targeted in the research. The study focused on the Kichwa ethnic group in small communities along the Napo River, at the limit of YNP. The Kichwa community was selected to the detriment of other ethnic groups (e.g., the Waorani nationality) because it was easier to reach using the limited available resources. The Añangu, Sani Isla, El Pilche, and Indillama communities were visited. As the study is part of PhD research, the PhD supervising commission within the implementing university issued the ethical authorization for the methodology before the field activity. The following steps were taken:

1. **Key respondent interviews** with five persons: two members of the YNP management team, one local guide, and two local community leaders (El Pilche and Añangu), using a snowball sampling technique starting with an initial interview [52], which helped us to obtain an overview of the areas where the main PA management risks were identified. These interviews also helped in completing/confirming the items to be used within the survey in terms of ESs and the drivers that influence forest ecosystem changes.

2. **Semi-structured household interviews** [53] with members of Añangu, Sani Isla, El Pilche, and Indillama communities were carried out to collect in-depth information about the nature of the forest–community relationship (including the most important ESs and their benefits for the community), dynamics, and change drivers of forest ecosystems. Purposeful sampling was used to ensure that relevant members of the community, in the context of the human–forest relationship, were included in the analysis. The following criteria had to be fulfilled to identify respondents who would suit the purpose of the study: (1) local engagement in practices related to forest ES use and (2) interviewed persons had to be old enough to be able to remember possible changes in forest ecosystem–community relationships. The structure of the interview was developed using the bibliographic research results and the key respondent interviews; it included the following sections: (1) background information, (2) the most important ESs and their influence on community wellbeing, (3) observed ecosystem changes and the identification of key drivers of change, and (4) questions about respondents’ environmental attitudes and options. A semi-structured interview guide is provided in Appendix A. A total number of 57 in-person interviews were held in June 2022. They were conducted face to face, and their duration varied between 40 min and 80 min. The interviewees were provided the option not to participate, to only answer some questions, or even to leave; informed consent was requested and received before starting the interviews. Data on respondents’ gender were not collected, nor was any information that would have helped in the identification of the respondents. The respondents were asked to refer to their entire household. Every interview was carried out by a team of two people (one researcher and one Kichwa guide/translator in the interviewee’s language of choice—Spanish or the local Kichwa dialect).
3. **Focus groups with community members** [54] (5–10 participants, some of whom were also interviewed previously): These focus groups were organized immediately after the household interviews in each community, with the participation of community leaders. They served to clarify, verify, or conclude some debate from the individual interviews. The participants were selected by asking those members of the community who had already been interviewed to invite other people whom they considered to be important in the community. During the focus groups, among the topics included in the interview, only those with uncertainties were addressed. The participants were encouraged not to feel stressed and to try not to share answers that they considered responses to the desires of the interview team [24].
4. **A focus group with the YNP management team** [24,55]: After completing the field visit, the YNP management team was contacted in order to discuss the preliminary findings of the secondary data collection and assessment process and the interviews with local communities. From the park management team, four members (two of them being key respondents) were invited to discuss the relationship between forest ESs—including their dynamic—and human wellbeing in and around YNP. The results of the focus group with the YNP management team members were recorded by the research team and used afterwards to validate and complete the results of the study.

2.3. Data Analysis

The data collected through the interviews, as well as the transcripts from the conclusive workshop, were analyzed using qualitative content analysis [53,56]. Based on the key respondent interviews, as well as the bibliographic research [57–59], a grid of codes/themes with four categories and several subcategories was developed even before structuring the survey (see Table 1). However, after the semi-structured interviews and the conclusive focus groups, the transcriptions were reviewed repeatedly, and some additional codes (subcategories) that reflected important themes were added. A contextual understanding was essential in identifying the themes used for the data analysis. The data analysis required a contextual understanding to identify these themes. The themes were split into

numerous subcategories to ensure that the respondents' perceptions were comprehensively captured. To organize the survey data, we used the ES conceptual approach [60]—linking the human benefits to ESs and classifying ESs into four main categories: provisioning, regulating, supporting, and cultural. Health was included in the provisioning ES category since, in all mentions regarding health, the respondents mentioned medicinal plants. Also, security, understood as the shelter of communities from external threats, was included in the regulating and supporting ESs.

Table 1. Themes used for qualitative content analysis (analysis grid).

Categories	Subcategories
Benefits	<i>Provisioning ES:</i> wood, water, food, medicinal plants, and various other materials for sustenance <i>Regulating and supporting ES:</i> biodiversity, climate regulation, and security <i>Cultural ES:</i> good social relations, cultural identity, recreation, and ecotourism
Changes in the forest	Forest surface, forest species, and other forest features
Forest change drivers	<i>Direct drivers:</i> oil exploitation, infrastructure development, small-scale agriculture, invasive species, mining, hunting, illegal logging, and climate change <i>Indirect drivers:</i> land governance and the promotion of extractive activities, poverty and the lack of income sources, the presence of colonists in the park area, health and the presence of new diseases, the loss of cultural identity, access to education, and low levels of sources for control and monitoring <i>The relationship between drivers</i> <i>The evolution of forest change drivers over time</i>
Expectations	<i>Opportunities and risks</i>

The qualitative analysis resulted in qualitative descriptions of both the relationship between ESs and human wellbeing and of the risks and drivers influencing the dynamics of socioecological systems. There were also quantitative results that were determined based on the total number of interviews and not the number of participants, as it was possible to observe consensus being reached among participants within a group interview. By numbering the times that the benefits/direct and indirect drivers appeared in the essay answers, charts were constructed. In addition, the records of the focus group team were essential for contextual understanding, and they were used to refine the analysis grid.

3. Results and Discussions

3.1. Ecosystem Services and Human Wellbeing

The topic of the benefits obtained by the communities from the surrounding forests attracted the respondents in a particular way; most of them insisted on describing how important the forests were to them.

Provisioning ESs had the predominant position in respondents' perceptions: they were mentioned 103 times in the transcripts. Forests were particularly mentioned as a reliable and continuous source of food for the community (Figure 2). Numerous species of flora and fauna were mentioned. Medicinal plants strictly related to health were the second-most-often-mentioned provisioning ES by the respondents. The benefits related to food and health for local communities have been mentioned in numerous studies [57,61–63], and the knowledge of YNP communities in the matter of the medical use of various flora species has been confirmed in studies carried out in the past [36,44,64].

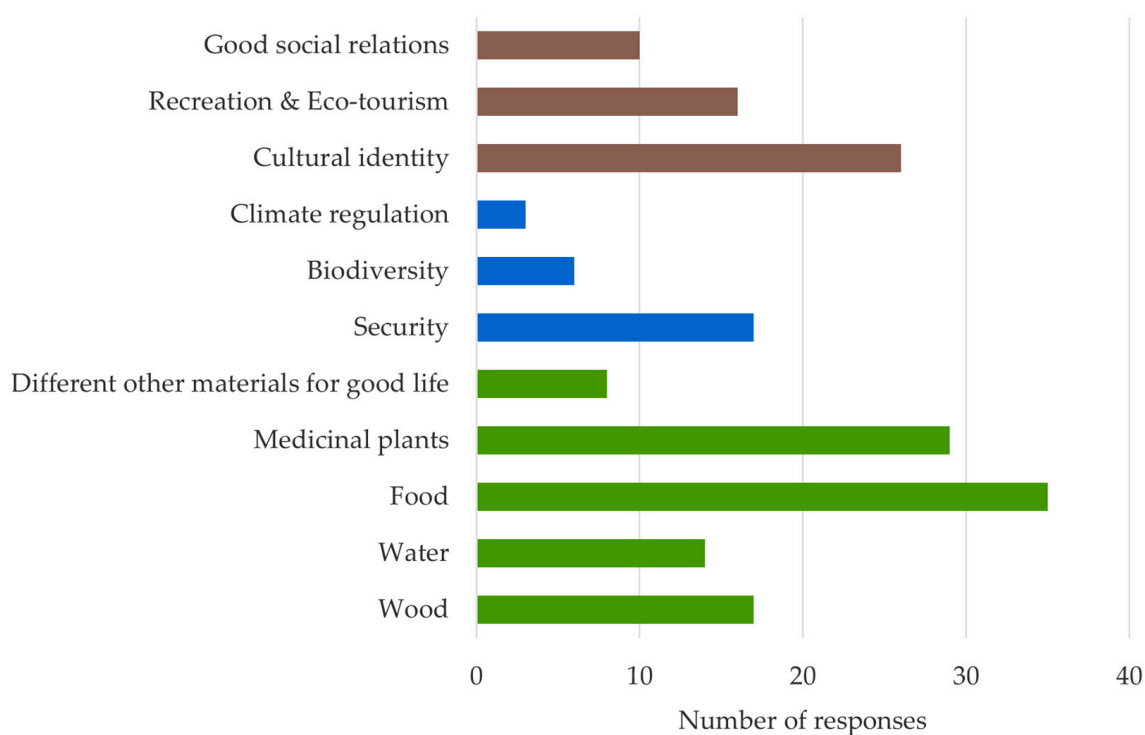


Figure 2. The main forest ESs identified by respondents in Kichwa communities (brown columns—cultural ESs, green columns—provisioning ESs, and blue columns—regulating and supporting ESs).

Cultural ESs were mentioned 52 times in the transcripts. Many respondents identified cultural identity as one of the most important benefits: the respondents tended to tell stories about how the isolation of certain members of the community in the forest provided these members the necessary qualification for providing spiritual leadership to the communities. This significant finding confirms the findings of other studies in the area [51], including some related to the Kichwa community in particular [35,46,65].

Regulating and supporting ESs were mentioned 26 times in the transcripts. Among them, security—the fact that forests can protect humans against external threats—was mentioned the most often.

The perceived importance of provisioning ESs, already proven in other studies [35,44,57, 61–64], did not equal in novelty the fact that several non-provisioning services occupied a very high position in the respondents' perceptions, including recreation and ecotourism (position 5), cultural identity (position 3), and security (position 4).

3.2. Drivers Influencing the Dynamics of the Sociological Systems

3.2.1. Identification of Drivers Influencing the Forest Ecosystem Dynamics

YNP has several social, ecological, and biophysical factors with significant effects on forest ecosystems. Threats to the park's ecosystem come, according to the studied literature and discussions with YNP administration members, from the loss of vegetation cover, changes in water bodies, the reduction of riparian forests, groundwater depletion, and soil erosion [24,28,32,46]. In addition, threats come from indirect effects within the park ecosystem, such as the loss of fish species habitats and habitat connectivity. In addition, changes in the life history stages of fish were observed, as well as modifications to forest habitats and cultivated lands [28,66,67]. It was understood that certain factors in the social–ecological system have a profound effect on its overall dynamics. These should be recognized, organized, and named to better describe their interconnectedness.

The most important forest changes that affect the socioecological systems, as identified and validated by the respondents and the participants in the focus groups, are as follows: deforestation (the loss of the natural forest surface), land use shifts (the forest's conversion

into grassland or cultivated land), land degradation (due to pollution and/or other types of degradation from anthropogenic causes), and species disturbance due to excessive use and the loss of biodiversity.

In this regard, a set of direct and indirect drivers that influence the dynamic of forest ecosystems were identified through the key respondent interviews and validated through the semi-structured interviews and focus groups with members of the community and the YNP administration team. Overall, we found that the interview respondents chose petroleum, infrastructure, and small-scale agriculture as the most important direct drivers of forest ecosystem change (Figure 3).

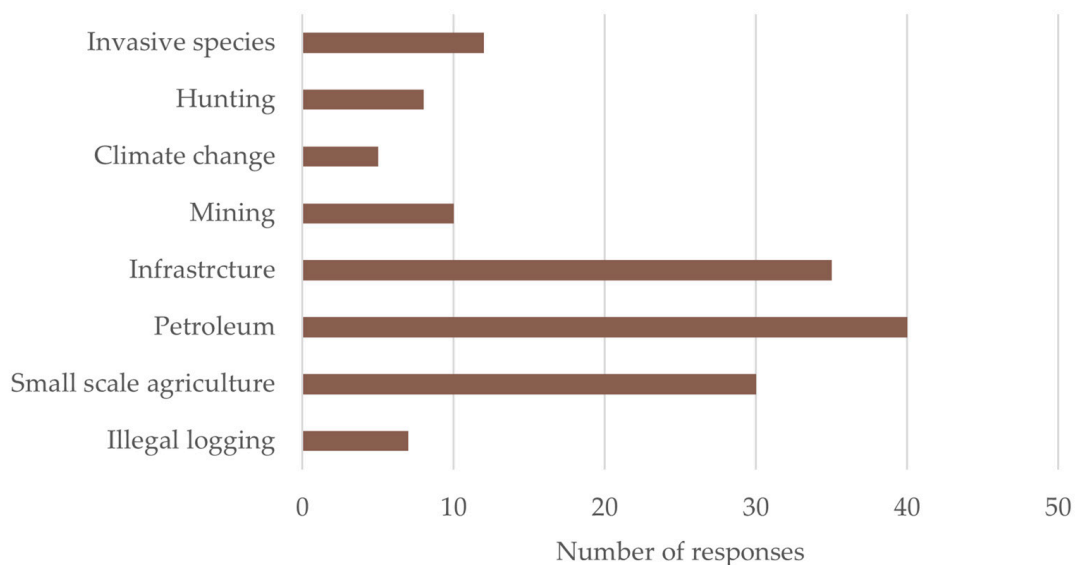


Figure 3. Direct drivers of forest ecosystem change reported in the Kichwa community.

Also, the results of the interviews indicated that land governance and promotion of extractive activities via the state, poverty, and migration were considered the most important indirect drivers of change (Figure 4).

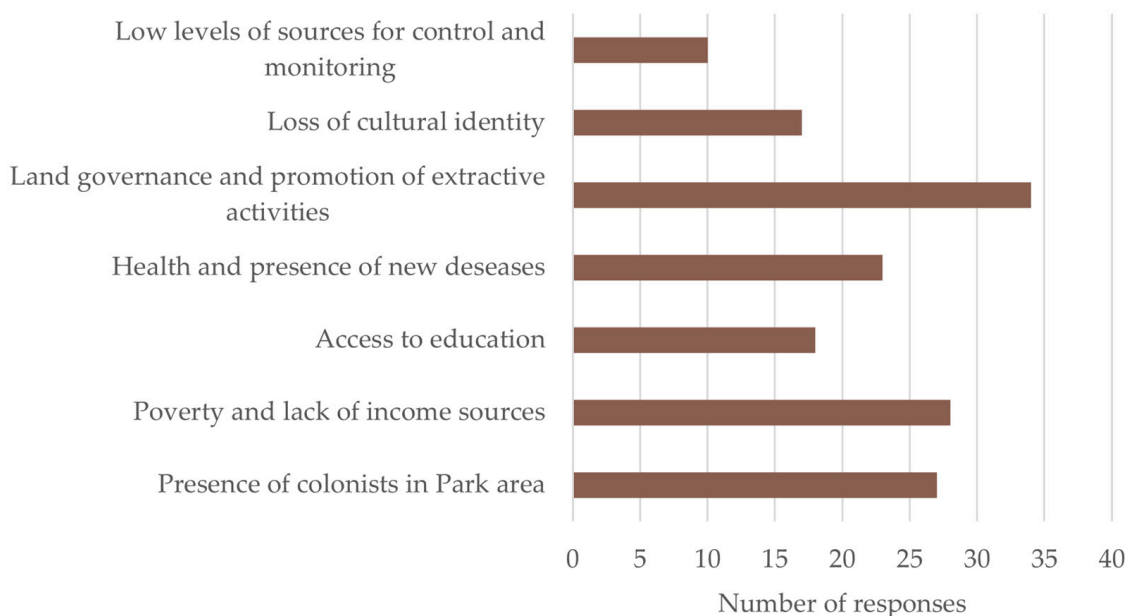


Figure 4. Indirect drivers of forest ecosystem change reported in the Kichwa community.

3.2.2. Description of Direct Drivers of Forest Ecosystem Disturbance

Different sources indicated surfaces in YNP affected by deforestation; often, these were directly or indirectly linked with oil extraction [68]. Road access to oil infrastructure has led to the deforestation of adjacent surfaces; for the ITT Block, new roads and extraction platforms were constructed to the detriment of the forest [24,68]. There were also sources indicating an indirect impact on deforestation. There was around 350 ha of deforestation determined by agricultural activities (i.e., colonization) along the Maxxus Oil road between 2012 and 2018 [67,68], while the same sources estimated a total deforested surface area (agriculture and oil exploitation) of 500 ha [68].

YNP is home to a wide variety of ecological niches; among the most notable are tropical rainforests, flooded forests, swamp forests, lowland forests, and high-altitude forests. This wide range of ecological niches provides habitats for a diversity of species. However, human activities threaten the survival of many species. According to expert opinion, the loss of ecological niches can have important repercussions on overall biodiversity and ecosystem stability, causing a decrease in overall biodiversity and a reduction in the number of species and interactions that make up the ecosystem.

Oil Exploitation

The largest oil reserve in Ecuador is located in YNP. This adds major challenges to already existing socioenvironmental problems that have been experienced by one of the most biodiverse places in the world since the establishment of YNP in 1979 [24]. The range of issues is amplified by the fact that YNP includes the Ethnic Territory of the Waorani nationality recognized by the Ecuadorian Constitution [48,69]. Oil drilling started in the 1980s in the northeastern part of the park [68]. To protect the Tagaeri and Taramenane ethnic groups (living in voluntary isolation), the Intangible Zone was designated and delimited. In the Intangible Zone, oil-specific activities are not permitted [68]. However, after the failure of the ITT initiative [41,70], intended to stop oil-extractive activities (2013), drilling activity has further expanded in YNP [24,68].

It is difficult to make a general statement on whether environmental pollution via oil companies is better managed today, as the level of environmental pollution and its management vary greatly, depending on the specific location and circumstances [71]. In some cases, improvements in technology and regulatory frameworks have led to a reduction in environmental pollution from oil extraction activities. For example, advances in drilling techniques have made it possible to extract oil with fewer spills and leaks, and increased penalties for environmental violations have encouraged companies to adopt more environmentally responsible practices [72]. However, in other cases, environmental pollution from oil extraction activities remains a major problem, and the level of environmental pollution has increased in recent years due to increased demand for oil and more intensive extraction practices. This is especially true in Amazonian regions with weaker regulatory frameworks, where companies can operate with fewer restrictions and lower levels of oversight [73].

Despite the observed land use changes [74], the respondents did not perceive deforestation as a significant risk for them unless it was associated with colonists' claiming the land for agricultural purposes [24,45]. Land rights and the lack of significant community benefits from using their land for oil activity are of great concern for the community members, as reported by Gilbert [75]. These findings were validated by the results of the focus group organized with the members of YNP: they consider the development of areas dedicated to oil activities to still be controllable, although oil drilling may be considered a major risk [24].

Infrastructure Development

There are numerous secondary documentary sources indicating the uncontrolled effect on biodiversity of oil drilling activity [67], as well as the fact that forest cover [76] and the social dynamics of indigenous communities [67,76] have also been affected.

According to the respondents, the influence of the oil-exploitation-specific infrastructure on forest ecosystems is visible. Access is limited, but members of the local communities use the roads to move more easily on the hard-to-reach terrain. At the same time, the settlers also use the roads, allowing them to reach much deeper inside the PA than was possible in the past. The respondents considered the direct effect of the infrastructure on forest areas to be limited, but the indirect effect, determined according to the possibility of colonization and the expansion of agricultural lands, is significant.

Small-Scale Agriculture

Small-scale agriculture has long represented an important activity for the communities in the investigated area [65]. The areas for which the category of use has changed from forest to agricultural land were quite reduced at the level of local communities. The activity of settlers, both towards the outer limits of the YNP and towards the interior, however, was seen as a danger and has been especially promoted by the development of infrastructure. Members of the YNP administration consider colonization and the practice of agriculture by colonists two of the most important threats to forest ecosystems.

Invasive Species

The introduction of non-native species can have negative effects on the park's ecosystems and the species that live there, as invasive species can compete with native species for resources [67,77]. In total, 12 respondents mentioned invasive species as a direct driver of forest ecosystem changes. Generally, they connected invasive species with monocultures and colonists' activities.

Mining

YNP is located in Ecuador's Amazon rainforest, and it is home to rich deposits of gold and other minerals that have attracted the attention of illegal miners. Illegal gold mining in YNP has had a significant impact on the park's ecosystem and the indigenous communities living in the area, and it has resulted in the destruction of large tracts of forest, the contamination of soil and water sources, and the displacement of local communities [78]. According to the interviewees, in recent years, efforts have been made to address the problem of illegal gold mining in YNP and to protect the park's ecosystem and the indigenous communities living in the area. For example, the Ecuadorian government has launched a series of initiatives aimed at cracking down on illegal mining activities and strengthening the control and surveillance of YNP.

Hunting and Poaching

The Kichwa community considers poaching and illegal hunting to possibly have very bad effects on the park's fauna, especially on the larger and more emblematic species. They expressed concern, in particular, about the fact that an increasing number of tourists are asking about opportunities to hunt. Also, the respondents considered hunting and poaching to have been rapidly growing in recent years and connected this phenomenon with the presence of colonists.

Illegal Logging

Due to very difficult transportation conditions, illegal logging was not yet considered—at least at the level of the YNP administration—a major challenge. There was no concession system in place, and the only significant wood quantities that were logged were connected with infrastructure development and activities for the colonists. Fewer than 10% of the respondents mentioned illegal logging as a forest ecosystem disturbance driver.

Climate Change

Rising temperatures and changes in rainfall patterns can affect the park's forest ecosystems and the species that live in them, causing range shifts and other ecological alterations.

Even if there are documentary sources referring to climate change as a possible driver of YNP forest ecosystem degradation, the targeted community still did not seem very concerned with climate change. Those few respondents who mentioned climate change referred mainly to changes in rainfall patterns.

3.2.3. Description of Indirect Drivers of Ecosystem Change

Land Governance and the Promotion of Extractive Activities by the State

For a long period, governments that changed frequently denied the existence of the isolated indigenous groups and, consequently, encouraged the opening of oil-related roads in YNP, triggering illegal logging [77]. When precious timber became scarce, the loggers mobilized the support of the hostile Waorani and entered YNP to harvest it [79]. This led to undesired contact with the self-isolated population [80] and caused human rights activists and indigenous representatives to appeal to international institutions to gain support for pressuring the Ecuadorian government to protect these groups [78]. Eventually, the government demarcated the 758,000 ha “untouchable zone” and adopted the National Policy for Isolated People in 2007 [79]. However, there are voices that claim that these measures are insufficient as long as there are no alternatives offered to oil, timber, or settlers surrounding self-isolated people. An oil memorandum was developed as a needed protection measure, while the line of argument regarding the rights of self-isolated people became the core of the Yasuni–ITT project, used by the government whenever human rights activists denounced the same issue for other zones designated for oil drilling (e.g., the Armadillo block) [76].

The interviews carried out revealed that, with the exception of the Indillama community, there is a tendency to consider collaborating with (or even contacting) oil companies to be undesirable because this will not bring sustainable benefits for the communities and may limit families’ choices and make them more dependent on uncontrolled sources. For example, community members lost their jobs during the COVID-19 pandemic and did not receive any support from their employers (oil companies). This result, however, contradicts previous studies [29]. In the case of the Indillama community, the respondents explained that oil companies are very closely connected with the community and that oil-related jobs reduce families’ forest dependence. All other communities’ representatives indicated that dependence on the forest is preferable to the precarious opportunities offered via oil activity. It is important to note that these communities have already seen the encouraging results of forest activities (e.g., logging) and ecotouristic activities [24,67].

Poverty and a Lack of Income Sources

A lack of income is a major problem for many of the communities living in and around the park [81]. Many of these communities are isolated and have limited access to markets and economic opportunities, making it difficult for them to earn a stable and sufficient income. In addition, the presence of settlers and resource extraction activities in YNP negatively affects the local economy. For example, the extraction of oil and other resources causes the displacement of local communities and generates changes in traditional customs and practices, such as agriculture and hunting [82]. To address these challenges, public and private initiatives are underway to promote the sustainable development of communities. For example, they provide training and education in sustainable agriculture and other livelihood activities, such as ecotourism and handicraft production. These initiatives aim to improve the opportunities and income generation of the communities until they become self-sufficient.

Many of the respondents referred to poverty and a lack of economic opportunities. As expected, many of the respondents linked economic opportunities to oil extraction activities and tourism activities. There was a clear tendency of the members of the interviewed communities to perceive the opportunities offered via oil extraction companies as traps and activities that cause a decrease in the independence and free will of the community

members. Tourism was seen as an important opportunity, even if—here, too—the period of the COVID pandemic produced a drastic reduction in activity.

Presence of Colonists in the Park's Areas of Influence

According to experts, the presence of colonists in YNP causes a series of problems within the park and its ecosystems [67,76,83]. Among the problems associated with the presence of colonists are deforestation, soil degradation, water contamination, the dispersion of invasive species, hunting, fishing, illegal logging, and the presence of weapons. The settlers engage in agriculture, slashing, burning, and cutting down large tracts of forest, causing habitat loss and fragmentation. Monocultures have caused soil degradation and nutrient depletion. Similarly, the agricultural and domestic activities of the settlers cause the pollution of rivers and streams. Settlers are the main agents that introduce invasive species, making them a threat to native species. In addition, this causes tensions and social conflicts with the communities, as settlers engage in illegal fishing and hunting. The opening of communication routes is another threat to flora and fauna [26,28,73,77]. The government has included control, surveillance, and education programs to raise awareness about the importance of preserving the park's wildlife [66]. However, law enforcement remains a challenge in many areas. To effectively address this problem, there is a need to increase resources for law enforcement and provide alternatives to local communities that depend on hunting for their livelihoods [62,73,84].

The presence of arms inside the park has several serious consequences: it generates violence and conflicts between illegal loggers and park guards who are in charge of protection and control inside the park and zones of influence. In addition, it increases ecological alterations and disturbances, and in general, the presence of weapons aggravates problems and places the safety of park personnel at risk [84,85].

The presence of colonists was also seen by the respondents as an important driver of forest ecosystem changes. Colonists' activity was often associated with a lack of sustainability. Members of the interviewed communities mentioned the fact that the increasing number of settlers would cause—despite attempts by indigenous peoples to promote the sustainable management of forest resources and to expand ecotourism activities—the expansion of oil extraction activities and agriculture on larger and larger surfaces, which would damage the activities of the communities.

In the perception of the analyzed communities, colonization was of great concern. The interviewees spoke of groups of non-indigenous people claiming land for agricultural activities and settling at the limit of YNP. Unlike the agricultural practices of Kichwa communities (an itinerant type of agriculture that does not harm the forest due to less-intensive agriculture and because the forest reclaims the land after a few years of usage [24]), the colonists' agricultural practices are relatively intensive and, thus, more harmful to the forest. The YNP administration representatives confirmed that colonization is a major concern. They noted both the weakness of the regulatory framework concerning the issue of new settlers and insufficient law enforcement capacities.

Health and the Presence of New Diseases

The health situation, influenced by new diseases, is complex in YNP and depends on several factors, such as the contact and presence of settlers, resource extraction activities, and the isolation of indigenous communities [44,86]. This causes the surrounding communities to have limited access to health services, with little health infrastructure and a lack of qualified personnel; community members often receive care in the medical centers of oil companies, which provide free care [67,86].

The arrival of settlers can also increase the risk of spreading new diseases [29,86]. For example, settlers and workers come into contact with each other and with wildlife, which can lead to unknown diseases. To address these challenges, initiatives are underway to improve access and health care in order to prevent the presence and spread of new diseases. However, the respondents expressed their particular concerns about these initiatives. Their

attitudes were complex: although they seemed to have significant confidence in their traditional way of treating different diseases using different species [64] or mystic techniques, they were still quite afraid and often mentioned cases of diseases brought by the colonists that produced undesirable effects.

Access to Education

The educational situation in YNP is challenging, especially for the indigenous communities living in and around the park. Many of these communities are isolated and lack access to basic services, including education. In many cases, indigenous communities living in Yasuní face linguistic, cultural, and economic barriers that make it difficult for them to access formal education. In addition, the lack of infrastructure, bilingual teachers, and educational materials can also limit educational opportunities for communities [29]. However, residents have the opportunity to attend public schools [67]. According to interviews with experts, there are also initiatives and programs aimed at improving the educational situation in YNP. For example, some nongovernmental organizations and indigenous organizations work to provide educational programs and services to the communities, such as literacy classes, cultural workshops, and environmental education. These initiatives aim to improve educational opportunities for the communities and help preserve the cultural heritage and traditional knowledge of the indigenous people. When asked about what they would do if they were in a decision-making position, many of the respondents mentioned that they would improve education, especially in terms of skills that are required for better communication in the tourism sector (for example, learning foreign languages).

Loss of Cultural Identity

As extractive activities in their ancestral territories expand, they have provoked violent confrontations between communities and company workers. At the same time, indigenous communities began to be portrayed as victims of acculturation, using violence in self-defense [66]. According to anthropological studies, this image was constructed with the assumption that, after their “pacification”, some indigenous groups, mainly the Waorani, would convert their subsistence practices into activities that could bring economic benefits, e.g., getting jobs in oil activities, practicing ecotourism, and manufacturing and selling specific handicrafts [81]. To a large extent, these studies have described the indigenous peoples as being affected by new problems, such as alcoholism, and facing severe culture shock and stress [87].

This has resulted in a high potential for the loss of cultural identity in YNP due to the presence of settlers and resource extraction activities in the area. Many indigenous communities have lived in and around YNP for centuries, and their traditional ways of life, including their customs, beliefs, and practices, are closely linked to the land and its resources [63,85].

However, the arrival of settlers, illegal logging, and other resource extraction activities disrupt these traditional ways of life and put pressure on indigenous communities to adopt new ways of life and cultural practices [67,76,88]. This leads to a loss of cultural identity and a decline in traditional knowledge and practices that have been transmitted from generation to generation [89]. In addition, the settlers can put pressure on the availability of natural resources on which indigenous communities depend for activities such as hunting and fishing, leading to a decrease in biodiversity and ecosystem degradation [82].

The respondents confirmed that they were concerned about losing aspects of their cultural identity. The respondents were proud of the way they traditionally used forest resources and often mentioned that they could deal with many challenges using their traditional knowledge. However, they also mentioned the fact that fewer and fewer people followed the traditional spiritual connection they used to have with the forest. Many of the respondents indicated that this issue had been evolving in a negative sense in recent years.

Low Levels of Resources for the Control and Monitoring of YNP

It is difficult to say definitively whether there has been a reduction in resources for YNP's control and surveillance without having access to current and complete data. However, discussions with members of the YNP administration revealed that there has been a cut in the park's management budget. In addition, in recent years, the Ecuadorian government has faced budget restrictions and cuts in public spending, which could affect the resources available for the control and surveillance of YNP [79].

In 2022, the Ministry of Environment (ME) reported the termination of 398 employees, 30 of whom were working in the country's protected areas. Experts fear for nature conservation in Ecuador, while the Association of Park Rangers demands the departure of the ME for its lack of capacity to lead the institution [79]. The effective control and monitoring of YNP are crucial for the protection of the park's unique biodiversity and for the wellbeing of the indigenous communities living in the area [90]. Insufficient resources for control and monitoring can lead to illegal activities, such as deforestation and poaching, which can have devastating effects on the park's ecosystem and the livelihoods of the communities living there.

It is important that the Ecuadorian government and other stakeholders prioritize the allocation of adequate resources for the monitoring and surveillance of YNP to ensure the protection of the park's unique biodiversity and the wellbeing of the communities living in the area [1]. This may involve working with international organizations, civil society, and other stakeholders to secure funding and support for monitoring and surveillance activities in YNP.

According to the results of the interviews, the Kichwa community is aware of and generally stays informed regarding the activities of the YNP administration. Community members proved to know the most important activities that the YNP administration was implementing. They also considered monitoring activities, as well as support activities in the matter of tourism promotion, to have been more intense in recent years. However, many of the respondents would have liked to have seen more involvement and, thus, more resources to be used in their favor by the YNP administration.

4. Conclusions

The complex relationship between local communities, impressive biodiversity, and industrial development pressures provides YNP with special importance from the socioecological perspective. Seeking to support the adaptive management of YNP, this paper has added new insights to better understand the struggle of the forest-dependent ancestral Kichwa communities in adapting to changing forest ESs. It has also proposed a complex and interdisciplinary methodology that can be used as a roadmap for similar studies in other areas.

This study faced limitations. The most important one is the fact that only one nationality, the Kichwa, was the subject of the study; other very important affected ethnic groups were not investigated in this study. Other limitations worth mentioning are the limited number of interviews, the inherent limitations of qualitative interpretation, and translation issues (sometimes from English to Spanish and into the Kichwa dialect).

The answer to the first research question (*What are the benefits for the local communities of the forest ecosystems within the PA?*) showed that forest ecosystems are of high importance for the investigated communities; food, health, and cultural identity were the most frequently mentioned ES benefits that the communities obtained from the forests, along with other very important benefits like recreation, wood, security, and water, as well as good social relations.

The selection of interviewees was based, among other factors, on the criterion of being old enough to remember possible changes in the forest ecosystems; almost all respondents indicated that changes had occurred in forest ecosystems and, consequently, in the community's way of life. Petroleum, on the one hand, as well as infrastructure development and the small-scale agriculture associated with competing communities of settlers, on the other, were indicated as the most important direct drivers of changes in forest ecosystems

(this answered the second research question). The findings confirmed the most important threats to both communities and biodiversity in YNP that had already been identified.

An original contribution of this paper is the clear identification of indirect drivers of forest ecosystems' change (which also responds to the second research question); the studied local indigenous communities perceived land governance as being the most important driver affecting forests despite the efforts made by the Ecuadorian state to promote the common ownership and management of the land. The perception of most of the respondents was that oil extraction activities were a threat, rather than an advantage for the communities, mainly because these activities do not reduce poverty or bring a significant income. The presence of colonists in the YNP area was also perceived as an important driver of forest ecosystem change.

This study contributes to enhancing the understanding of how communities in YNP perceive the dynamics of the interconnected social and ecological systems. Thus, it supports finding solutions to permanently adapt the governance of the area in general and the YNP management in particular. Some of the directions for action would be improving land governance, especially regarding the authorization of land use by colonists, and finding solutions for distributing the revenues that come from the use of underground resources.

In addition to these case-specific conclusions and recommendations, this research contributes to the broader debates on the relationship between indigenous communities, forest ecosystems, and PAs. The results clearly suggest that socioecological systems must be permanently monitored by scientifically recording the perceptions of local communities. This is needed not only to understand the dynamics involved but also to capture and understand the traditional benefits that communities receive from forests. This research emphasizes the fact that reducing poverty through fair revenue distribution can bring underground resource utilization closer to sustainability. It also contributes to the current debate surrounding the requirement that authorities govern the land and control the colonization process, as this constitutes an emerging issue.

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Appendix A

Table A1. Interview guide.

Criteria	Questions
Background information	What is your main occupation in the community? Please describe briefly what your work consists of in a regular day. For how long you have been working/living in the area?
The most important ES and its particular influence on community wellbeing	What benefits do you obtain from the forest surrounding your community? Why did you identify these benefits? How do you use the benefits you mentioned before?

Table A1. Cont.

Criteria	Questions
Observed ecosystem changes and the identification of the key drivers of change	What changes have you observed in the forest ecosystems during your life? How do these changes affect your life and the lives of community members? What activities or causes determined the above-mentioned changes?
Questions about respondents' environmental attitudes and opinions	Do you anticipate changes to the forest in the future? Please explain. If you were to decide on future governmental initiatives for the area management, what would these be?

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