

EXPLAINING SMALLHOLDER FARMER TROPICAL
DEFORESTATION IN NORTHWEST ECUADOR

A THESIS

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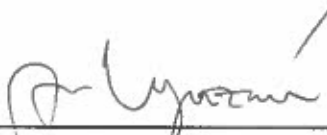
MASTER'S OF ARTS

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Abstract

Loss of primary forests threatens biodiversity and species richness, as well as access to ecosystem services like clean water and fertile soils. Despite substantial international attention and increased efforts to curtail forest degradation, rates of deforestation in the Latin American tropics are still high. The Mache-chindul Ecological Reserve (*Reserva Ecológica Mache-Chindul, REMACH*) in northwest Ecuador is an example, with the highest proportion of deforested land among the nation's Ecological Reserves. While the protected area conserves some of the last standing patches of the Chocó-Darien ecoregion's primary forest, the reserve has been named a deforestation hotspot. Previous studies identify agricultural expansion as the most important risk factor for continued land clearing in the area. This study investigates these high rates of agricultural land clearing from a political economy of the environment perspective. I review Rudel and Horowitz's (1993) theory of tropical deforestation, applying the theory to the case of deforestation in and around the REMACH. Data were collected in July and August 2021 using a land-use survey, semi-structured interviews, and observation. This case demonstrates that lead institutions, such as a government colonization program and development banks that support commodity market expansion, in tandem with growth coalitions of smallholder farmers fleeing anthropogenic climate change in their home province, produce decisions to deforest. Explaining the social organization of tropical deforestation is key to understanding why smallholder farmers decide to deforest, advancing the discourse towards equitable solutions.

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1. Introduction

According to the Intergovernmental Panel on Climate Change, an estimated 23% of total anthropogenic greenhouse gas emissions derive from land-use changes mainly related to agriculture and forestry (IPCC 2021). Loss of primary forests continues to threaten biodiversity and species richness (Wolf et al. 2021) and access to ecosystem services like clean water and fertile soils (Biggs et al. 2012; Knoke et al. 2020). Despite substantial international attention and increased efforts to curtail forest degradation, rates of deforestation in the Latin American tropics are still high (Camba Sans, Verón, and Paruelo 2021; Curtis et al. 2018). The need to halt deforestation is urgent if we are to ensure healthy and sustainable futures for humans and the planet (Abhilash 2021; Talukder et al. 2021).

There is a vast literature that points to commodity-based agriculture as a primary factor leading to deforestation, both globally (Hoang and Kanemoto 2021) and regionally, in Latin America's tropical rainforests (Fagua, Baggio, and Ramsey 2019; Van Der Hoek 2017). The scholarship on agriculture-driven deforestation, however, is dominated by the natural sciences, which relies heavily on satellite imagery to measure patterns of land-use change (see, for example, Kleeman et al., 2022). While measuring forest decline is important and necessary, these studies cannot explain the macroeconomic factors or the individual needs and motivations leading locals to deforest. An emphasis on measurement potentially results in oversimplified and reductive explanations that in turn limit the effectiveness of conservation solutions (Schipper, Dubash, and Mulugetta 2021).

There is an increasingly better understanding of the association between both land tenure transitions and agricultural production practices with forest coverage rates in Ecuador (Rudel et al. 2016; Rudel and Hernandez 2017). Sociological theory and methodology have an important,

but often underappreciated, role to play in advancing our understanding of the structural anthropogenic drivers of climate change in general, and deforestation specifically (Dunlap and Brulle 2015; Osborne et al. 2021; Tester 2020). The political ecology framework allows us to explain why people decide to deforest varied proportions of land (Rudel and Horowitz 1993). This sociological theoretical approach highlights the political and economic dynamics behind the control over natural resources, like forests (Merlinsky 2021). Identifying the major social actors that play a role in environmental degradation is an essential step in explaining the link between global processes and ecosystem disruption (Lewis 2016).

Ecuador is aptly suited to serve as a case study location for tropical deforestation because it is a global center of biodiversity and forest ecosystems, yet rates of anthropogenic deforestation remain high, including in protected areas (Kleemann et al. 2022; Van Der Hoek 2017). According to the International Union for Conservation of Nature (IUCN) Red List of Ecosystems, about 22% of forest ecosystems in Ecuador are classified as threatened, primarily due to human activities such as logging, agricultural, and cattle grazing (Noh et al. 2020). Van der Hoek (2017) found that while rates of deforestation are generally lower inside of governmentally protected areas in Ecuador, conservation effectiveness varies, with some areas experiencing high rates of deforestation despite federally protected status. The Mache-Chindul Ecological Reserve (*Reserva Ecológica Mache-Chindul, REMACH*) is an example. Kleeman et al. (2022) names the REMACH one of Ecuador's most notable "deforestation hotspots" and asserts that agriculture is the most important driver of deforestation both inside the REMACH boundaries and within a 5 km buffer zone surrounding the protected area.

The Ecuadorian national system of protected areas (*Sistema Nacional de Áreas Protegidas, SNAP*) dictates land governance on about 20% of Ecuador's land area, including

protected lands and ecological reserves (MAE, 2015). Nationally managed protected areas, such as Ecological Reserves, can successfully protect biodiversity and important ecosystems (Rodrigues-Souza et al. 2015; Wang et al. 2021). Yet there still exists what Knight et al. (2008) calls a “knowing-doing gap,” where conservation assessments do not always translate into conservation action and effective implementation due to the separation of priority areas from the activities that destroy them.

This study addresses the gap. I propose an explanation to why farmers clear land for agricultural purposes inside and immediately surrounding the boundaries of the REMACH. What are the political and economic contextual dynamics behind the decision to clear land? Who are the social actors that play a role in land use and tenure transitions? Overviewed in the following subsection, Rudel and Horowitz’s (1993) theory of tropical deforestation provides a sociological theoretical frame to question why the REMACH is considered a deforestation hotspot. I argue that the pattern of deforestation in the REMACH area is consistent with this theory of tropical deforestation and that a political ecology analytical framework, which identifies the social and political actors involved in environmental degradation, is best suited to explain why agriculture is routinely noted as an important factor in tropical rainforest degradation. I identify a handful of the root causes of agriculture driven deforestation in Northwest Ecuador. In the following subsection, I will introduce the main tenets of a sociological theory of deforestation to highlight known trends in land use decisions associated with smallholder farmer settlement. Section 2 introduces the methodology and section 3, the context for the case study. Section 4 describes this study’s findings, describing land use activity and identifying the structural mechanisms behind agricultural decisions that lead to deforestation. Section 5, the discussion and finally, the Conclusion in section 6.

1.1. A sociological theory of tropical deforestation

Rudel and Horowitz (1993) present a theory of smallholder tropical deforestation from the perspective of political ecology. The dynamic social arrangement of political and economic lead institutions in relationship to growth coalitions of poor peasants explains the pace of deforestation in tropical regions. Pre-1990 foreign and national lead institutions, such as private corporations, government agencies, development banks, financed road construction that penetrated isolated forested areas and expanded capitalist development. In Ecuador public land settlement initiatives, legally and politically referred to as colonization programs, were funded by powerful lead institutions such as the United States Agency for International Development (USAID) in support of capitalist expansion (Parsons 1957; Rudel and Horowitz 1993; Striffler 2002). Colonization programs facilitated the migration of coalitions of marginal smallholder farmers to these newly opened forested regions (Gondard and Mazurek 2001). Road building and assigning individual families landholding plots for cultivation were key to controlling the countryside, instilling a firm ideology of modernity, and developing participation in the export economy (Durand and Lazos 2004; Riofrancos 2020; Rudel and Horowitz 1993). Growth coalitions were formed by smallholder farmers who amassed their few resources to overcome the obstacles of settlement. A symbiotic relationship between lead institutions, often with the support of foreign powers, and growth coalitions initiated the destruction of the forest, with the 1970s being the height of tropical deforestation in Ecuador (Rudel et al. 2009).

During the 1990s a shift towards agricultural enterprise-driven deforestation occurred in the tropics (Rudel et al. 2009). Increased urbanization, globalization, and technological modernization resulting from the Green Revolution induces the expansion of international agricultural commodity markets (McMichael 2012; Patel 2008; Rudel et al. 2009). Farmers

molded their production methods and land clearing practices in response to the pressures of the globalizing and expanding commodity markets (Meyfroidt et al. 2013). The result today is a fragmented forest landscape, where semi-subsistence smallholder farmers clear land either on the fringes of large forests or, if their production is more market-oriented, on transportation corridors. The subsequent building of feeder roads induces further deforestation, leaving islands of forest scattered throughout (Rudel and Horowitz 1993). Forest changes occur as societies respond to global economic development, industrialization, and urbanization (Mather and Needle 1998; Rudel et al. 2005).

Rudel and Horowitz (1993) and others advocate for a political ecology—or political economy of the environment framework—to address ecosystem regeneration in an equitable and community engaged manner (Dunlap and Brulle 2015; Merlinsky 2021; Lewis 2016; Osborne et al. 2021). The sociological approach identifies the political and economic considerations that affect a farmer’s decision to clear land. Locating these individuals in a complex socio-political web where their land use decisions are a result of the options available to them based on their social, political, and economic position, broadens our understanding of tropical deforestation, and alleviates these smallholder farmers from all-encompassing blame for environmental destruction. The analytical approach aligns with the concept of “positionality” that feminist scholars use to assert an equitable and just system of knowledge production (Haraway 1988; Speed 2008). Analyzing social positioning through the lens of the partial perspective moves us beyond land use descriptions that neutralize social inequalities (Asad 1973; Gough 1968; Harding 1992). Rural land holders with production-based livelihoods are victimized for causing environmental problems like deforestation, when in fact their land use decisions are canalized and directed by national and international politics, sometimes set in motion in decades previous

(Sullivan-Wiley and Teller 2020). This study describes the local, regional, and international-scale social, political, and economic contexts in which smallholder farmers make decisions to rationalize their land use choices and redirect the discourse towards equitable solutions.

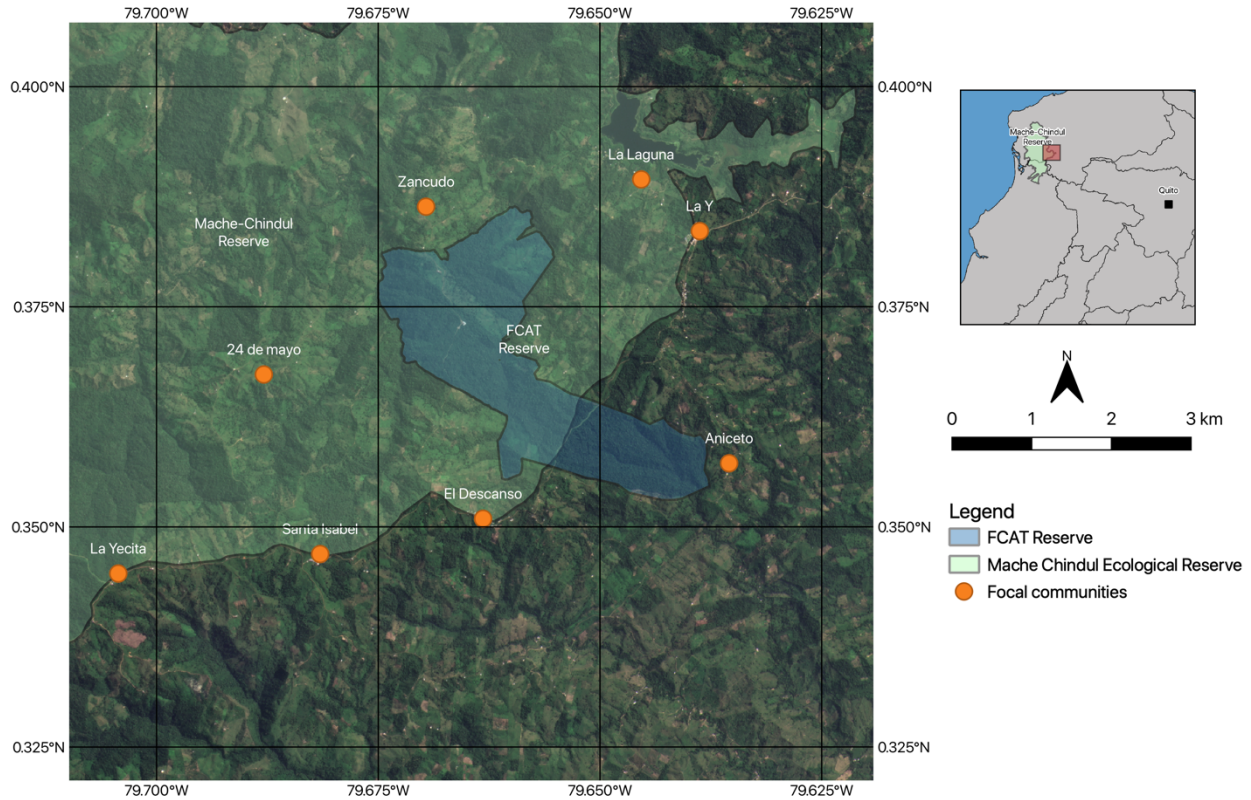
2. Case Study Context

Our study region is located in Esmeraldas province in Northwest Ecuador. The Parroquia de Cube, where all research activities were carried out, is in the municipality of Quinindé, and encompasses a portion of the western border of the Mache-chindul Ecological Reserve (*Reserva Ecológica Mache-Chindul, REMACH*). Esmeraldas province experienced rapid development in the decades leading up to the reserve's founding. Rudel (2000) notes the increased rate of forest clearing in Esmeraldas province following the construction of roads and the proliferation of colonist farmer settlements through colonization programs in the 1970s. Today, the province is a national agricultural locale. According to publicly available data from 2020 on The Ecuadorian Ministry of Agriculture website, after Manabí province, Esmeraldas dedicates the largest total surface area of land to cultivated pasture (222,454 ha). The region is also well known for its considerable shrimping industry and oil palm plantations, with cacao production on the rise (Hazlewood 2012; Speiser 1993). Moreover, a major onshore oil pipeline, the Trans-Ecuadorian Pipeline System (*Sistema de Oleoducto Transecuatoriano, SOTE*) traverses the Andes Mountain range, bringing crude oil from the Amazonian region to the pacific port city of Esmeraldas in Esmeraldas province. A pressure control station for the oil pipeline created the kilometer 80 exit off highway E20 near Quinindé, where the dirt road out to the REMACH and our field site begins.

The *Reserva Ecológica Mache-Chindul* (REMACH) is a government-managed Ecological Reserve established on August 9, 1996. In Ecuador, an Ecological Reserve is defined as “a natural area with little human intervention” (translated from Spanish to English by author, <http://areasprotegidas.ambiente.gob.ec/info-snap>). The founding of REMACH was initiated by private and public environmental agencies to protect the last standing patches of primary coastal humid forest habitat, an ecosystem that was at risk of extinction and home to diverse species of flora and fauna (Registro Oficial No. 29, 1996). REMACH is part of the Chocó-Darien ecoregion, a geographical area defined as both a top 25 biodiversity hotspot and as a deforestation hotspot (Fagua et al. 2019). Despite status as a protected area, between 2000-2008, 10.1% of the reserve’s 119,931 ha were deforested, a proportion that is the highest among the designated “Ecological Reserves” in the country (Kleemann et al. 2022; Van Der Hoek 2017). Lopez, Sierra, and Tirado (2010) attribute the loss of over 85% of Esmeraldas primary Chocó forests to logging, agricultural expansion, and infrastructure development. Deforestation’s prevalence in REMACH—notwithstanding protected status—makes the reserve an ideal field site to investigate the structural mechanisms that lead to agriculture-driven deforestation.

The *Fundación para la Conservación de los Andes Tropicales* (FCAT) is an internationally funded, Ecuadorian-based non-profit organization established in 2013 with a mission to protect and restore Chocó habitats (<https://fcatecuador.org/>). Located in the Parroquia de Cube, FCAT manages a private reserve within and just beyond REMACH’s boundaries. The organization invites Ecuadorian and foreign researchers to investigate and protect the region’s endemic flora and fauna species. Dr. Jordan Karubian, a founding member of FCAT and professor of tropical ecology at Tulane University, invited me to collaborate in understanding the everyday life of the communities surrounding the FCAT reserve (Figure 1).

Figure 1: Field Site Map



3. Methodology

3.2 Survey design and implementation

I examined land use and agricultural production today by using a 45-question household survey carried out among 70 households who farm land within or bordering the boundary of the Mache-chindul Reserve (survey in Appendix A). Containing both open-ended qualitative questions and measurable quantitative questions regarding land use decisions, the mixed-method data collection tool is useful for providing a rich account of agrarian life. Subject recruitment for

survey participation was carried out by FCAT. The methodology backing the design of the land use survey derives from Schons et al. (2019), which investigated smallholder land clearing in the Brazilian Amazon.

I conducted fieldwork during July and August 2020 in focal communities within the Parroquia de Cube of Canton Quininde in Esmeraldas province, Ecuador (see map in Figure 1). All subjects engaged in some form of agricultural production, the majority of whom ranch cattle and produce cacao. Basic land use information and correlated income data was obtained. I am unable to calculate a general annual income for the subject population as my aim was to understand income related solely to land use activities, rather than total household level income (i.e., remittances, off-farm labor, etc.). Descriptive statistics were analyzed through the data analysis program, SPSS (version 27.0).

3.3 Qualitative analysis

Interviews with key stakeholders such as elders in the community and officials from the local branch of the Ministry of the Environment provided descriptive narrative accounts of land use decisions on individual and institutional levels. To best capture the social web in which landholders make decisions today, key stakeholders were prompted to recount the history of various institutional interests in the area. For officials from the Ministry of the Environment, this meant telling the story of the founding and management of REMACH. For community elders, this meant discussing landscape changes over time, and the comings and goings of various non-governmental organizations (NGOs) and state agencies in the region. These qualitative accounts flesh out the archival work and literature review of the influence of national and international institutions in the area, contributing to a robust understanding of the structural (economic,

political, institutional) and cultural (emotions, affinity towards nature) mechanisms that factor into land use decisions and associated land cover change. All data were coded, and identifiable information was removed from the datasets to ensure compliance with ethical research guidelines. Tulane University's Institutional Review Board (IRB) approved all data collection and project materials on July 9th, 2021 (REF # 2021-691).

Interviews with key stakeholders, qualitative responses from survey interactions, and fieldnotes were virtually transcribed by a research assistant and by the author. All data in this publication were translated from Spanish to English by the author. Qualitative data were uploaded to the data analysis software, Nvivo (version 20.5.0), and then coded into thematic categories. Emergent qualitative narratives in response to prompting open-ended survey and interview questions were pulled from the thematic codes.

3.4 Archival work and literature review

Rudimentary archival work and literature review was conducted to embed contemporary data into a historical account of the political economy. Documents were retrieved from various municipal governing bodies in Quinindé, Esmeraldas province, and from library archives. Decentralized governance policy in Ecuador transferred the rights to development and management of conservation efforts to sectoral governments and civilian bodies (*La Ley Especial de Descentralización y de Participación Social*, 1997). As such, I felt it important to include documentation from community archives, analyzing pre-existing local reports on community development, reserve management, and land use. All archival data are stored alongside the quantitative and qualitative data on a password protected computer.

4. Results

4.1 Land use and subject population

4.1.1 Demographics

I spoke to households with farmland both inside and bordering the Mache-Chindul Reserve who identify as residents of the following eight communities: Zancudo, La Laguna, La Y, Aniceto, El Descanso, Santa Isabel, La Yesita, 24 de Mayo (Figure 1). The female head of household was present at the majority of survey interactions (78%). The average age of female respondents was 46 (± 14), while the average age of male respondents was 51 (± 13). Levels of educational attainment varied across age, but the majority completed primary school (55.8%) and 15.9% continued to study into secondary school. About 83% of survey respondents had family ties to Manabí province. Most survey respondents migrated to the region (87.5%), while 12.5% were first generation residents of Parroquia de Cube. The majority of the respondent population (62%) acquired their land after the founding of REMACH in 1996 (Table 1).

Table 1

Demographic and descriptive characteristics of respondent population (n = 69).

**Reserva Ecológica Mache-chindul (REMACH)*

		% of respondents
Gender	Female	39
	Male	22
	Both heads of household present	39
Age	20-34	19
	35-49	30
	50-64	35
	65-79	16
Highest level of educational attainment	No formal education	12.4
	Primary school	55.8
	Secondary school	15.9
	Professional school	13.3
	College/university	2.7

Family origins	Manabí province	83
	Esmeraldas province	11
	Other	6
Timing of land acquisition in the Parroquia de Cube	Pre-REMACH* founding	38
	Post-REMACH founding	62

4.1.2 Land acquisition and clearing

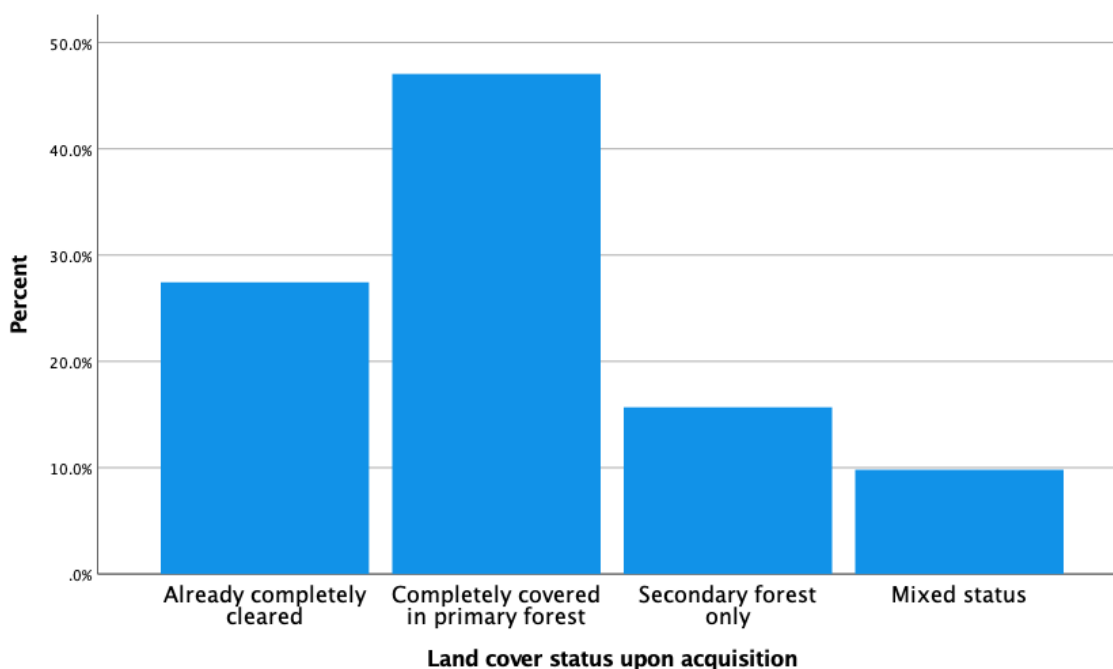
In my interactions, subjects frequently spoke about arriving to the area to find “*pura montaña*” (primary forest). I further investigated land use decisions upon initial property acquisition to understand how land transitioned from *pura montaña* status to agricultural expanse. Household level land clearing decisions, such as the choice to clear primary forest for subsistence and other agricultural purposes upon land acquisition, were assessed by asking respondents to report on 1) the total area in hectares of their property, 2) how they acquired their land and whether they received an official title for it, and 3) describe what their land looked like upon first sight and 4) report on area of land deforested since property acquisition.

While respondents reported landholdings between a minimum of 0.5ha and a maximum of 200ha, 71.6% of respondents report that their land area is 20ha or less (Table 2). These small-scale farmers acquired their land mostly through purchase (53%) or inheritance (40%). About 62% of respondents do not have any official title for their land, however, many of these households who live within the boundaries of the reserve explained that they do have possessory rights, and that the process of obtaining an official title has been a challenge since the reserve’s founding and subsequent engulfing of their land. The households who currently obtain official

land titles for their properties tend to be located outside of the REMACH boundaries in the towns of La Y and Aniceto (see map).

Respondents were asked to report on the state of their land (completely forested, completely cleared, secondary forest or mixed state) upon acquisition (Figure 2). Among the entire respondent population, including households who came before and after the reserve's founding, 47% acquired land that was completely covered in primary forest. Survey respondents who reported obtaining land that was entirely "*pura montaña*" (read: completely forested), elaborated on the physical challenges of clearing land with hand axes or, if they could afford it, a rented chainsaw.

Figure 2: Land cover upon property acquisition



Subjects who acquired properties covered partially or entirely with primary forest, were prompted to report on the number of hectares of land they had personally cleared since obtaining the property. Of those whose land was covered completely in primary forest at the time of acquisition, respondents reported clearing an average proportion of 92.5% of their land over time. Among this sub-population, those whose land resides outside of REMACH have deforested 99.06% of their land and those with land inside of the reserve's boundaries have deforested 87.65% of their total land area (Table 2).

Table 2
Summary of land uses

	%
Proportion of land cleared on properties completely covered in primary forest upon acquisition (outside REMACH)	99
Proportion of land cleared on properties completely covered in primary forest upon acquisition (inside REMACH)	87.7
Percent of subject population who cultivate cacao	92.6
Proportion of land dedicated to cacao (for those who report growing cacao)	43.9
Percent of subject population who graze cattle	50
Proportion of land dedicated to pasture (for those who report grazing cattle)	56.2

4.1.3 Agricultural activity and household economics

To understand how residents of Parroquia de Cube use land today and to gain a basic sense of their socioeconomic situation, survey respondents were prompted to report on land area devoted to agriculture and dollars of agro-inputs dedicated to each of their primary agricultural

activities. I also inquired about harvest quantities and market access. Finally, respondents were asked to speak to their perception of household food sufficiency and wellness.

The dominant agricultural activities among survey respondents were cacao cultivation, cattle ranching, and *gineo* (bananas). Occasionally, households reported growing passionfruit and yuca for market. These crops served to support field transitions as they lined new cacao rows but were removed once the cacao plant reached a certain size. Considering that 92.6% of respondents grow cacao for export and 50% graze cattle, I focused primarily on these two agricultural practices in supplemental survey questions (Table 2).

Respondents who grow cacao dedicate on average 43.9% (range: 0.5 ha, 30 ha) of their total land to cacao cultivation. Of those who cultivate cacao, 66.7% report using some form of agro-input on their crop. Two different cacao varieties are grown in Parroquia de Cube, one native and one hybrid. The *injerto*, or hybrid, variety is gaining traction as the most commonly cultivated variety of cacao as, according to producers, it boasts higher yields than the more aromatic *nacional*, or native, variety. Cacao *injerto*, as opposed to *nacional*, demands monocultural full-sun production, and according to our survey increases the probability of agro-input use by 34%. About 53% of survey respondents grow only *injerto* cacao, while 11% grow only *nacional*, and 36% were undergoing a transition from the native to the hybrid cacao at the time of data collection. Bank loans were often reported to aid the transition between cacao types. All cacao producers sell to a sole cacao aggregator in the centralized town of La Y (see map), who they report offers the same price for the *injerto* as he does for the *nacional* variety. The average rate for cacao sales in July 2021 was \$60 per quintal (100 lbs) for semi-dried product. Considering that cacao producers in our sample harvest on average 175 kg of cacao/month and that on average they spend \$20/month on agro-inputs for their cacao fields, we estimate that

cacao growing households receive an average monthly income of about \$212 before any household costs such as food staples, medicines, and transportation.

About half of survey respondents graze cattle. These households dedicate on average 56.2% of their land to pasture. Cow herd size varied with 200 heads being the maximum number for any household. The average herd size was 13 (\pm 31) cows. Generally, survey respondents reported reliance on their cattle primarily for household processing and consumption of cheese, rather than large scale commercial production. Occasionally, dairy and meat transactions occurred between neighbors and in the central town of La Y (see map). The average dollar amount farmers spent on bovine medications and vaccinations annually was \$18/cow.

Overall, survey respondents report that their household is food sufficient (72.6%) and that their basic clothing needs are met. As I transitioned into questions regarding quality of life, respondents would often trail into anecdotes about the positive developments of the area - the building of the health center, new schools, the construction of the road, for example. About 82% of respondents live on their farmland. Often respondents would comment on how the COVID-19 pandemic did not affect their communities like it ravaged through the urban areas of Ecuador because of their proximity to trees which produce "*aire fresco*" (fresh air). Just about 70% of households report no chronic illness among individuals living in the home. Half of respondents own a motorcycle and 63% own a horse or mule to meet transportation needs. Just over half of households (52%) do not have a bank account. Around 80% collect, rather than purchase, water for household consumption and 72% of those households that collect water have piping to bring the water directly to their homes. On average, households spend about \$180/month on food staples and \$13/month on electricity costs.

4.2 Structural mechanisms of deforestation

4.2.1 State-facilitated colonization

Apart from one household in the town of Zancudo that reported family arrival to the region in 1942, the earliest any household indicated having migrated to and acquired land in the area was 1976. As previously noted, some households indicated assistance from government programs for land acquisition. Based on literature and archival document review, we found that the influx of migrants from Manabí to Esmeraldas province was a focal point for state-facilitated colonization programs in the 1960s-80s (Gondard and Mazurek 2001). A state agency called The Ecuadorian Institute of Agrarian Reform and Colonization (*el Instituto Ecuatoriano de la Reforma Agraria y Colonización, IERAC*) supported the transformation of *tierra baldía* (vacant lands) into productive agricultural land by registering plots with *colonos*, or colonist farmers whose role was to settle the land (Registro Oficial N. 297, 1964). These farmers were nationally referred to as colonists and their migration to the forest frontier was facilitated by the state. Two laws led to the formation of IERAC, the *Ley de Reforma Agraria y Colonización* (enacted 11.07.1964) and its corollary *Ley de Tierras Baldías y Colonización* (enacted 09.28.1964). Both were drafted by the Junta Militar del Gobierno and backed by the American-led Alliance for Progress (Gondard and Mazurek 2001). The incentive behind the inscription of the two 1964 laws and the creation of IERAC was twofold. Two departments with interrelated, but distinct missions were to exist under IERAC; one focused on agrarian reform and the other on colonization (land settlement). Agrarian reform on the part of IERAC expropriated “unimproved” land or plots abandoned for at least three years and redistributed these areas to encourage “high investment and levels of efficiency” (Registro Oficial No. 297, 1964). The cost of expropriated land to potential beneficiaries depended on the “productive capacity” of the land.

It was hoped that these programs would discourage collective peasant organization and enforce an efficient capitalist system where new small-scale landholders play a role in the commodification of land (Goodwin 2017). Frontier development in Esmeraldas province ramped up with the 1964 *Ley de Tierras Baldías y Colonización* as extractive export industry, like oil and fruit export companies, became interested in the potential of these peripheral lands (Gondard and Mazurek 2001; Riofrancos 2020).

In the 1950s, a thoroughfare was constructed connecting Quito to Quinindé where the Río Esmeraldas became navigable out to the sea for international export (Parsons 1957). The road was constructed to increase market access and facilitate the mission of colonization by ensuring a direct link from colonist farmers to value chains (Harvey and Knox 2015; Rudel 2000). During this time, the Ecuadorian government enacted a land-use policy, stating that “to obtain title to *baldío* [vacant] lands, the settler must have put at least one-fourth of his 50-hectare claim into cultivation within a period of five years” (Parsons 1957). This statement is consistent with the qualitative data from key stakeholders:

The single worst thing that contributed to deforestation here in the Zona was IERAC. Colonos migrated here, grabbed land, and then went to register that land with IERAC. They would only officially allocate you the land if you had cleared at least 50% for agriculture. – Male resident (1/25/2022)

Deforestation was necessary to cultivate cash crops and stake ownership of land; therefore, a central precondition of restructuring the landscape for commodity export.

4.2.2 *Fleeing drought, importing agri(culture)*

Migrants from Manabí province spilled into Esmeraldas, responding to infrastructure developments and increasing Esmeraldas’s rural population from 85,262 people in 1962 to 131,005 people in 1974 (Speiser 1993). Environmental degradation and anthropogenic climate

change in Manabí caused a dire economic crisis for farmers living in areas of “high vulnerability,” which according to Macías Barberán et al. (2019), constituted Manabí’s deforested and bare soil zones. Drought conditions in Manabí province were continually cited as a major factor pushing subjects to leave their homes and come to Parroquia de Cube:

We left [Manabi] because of drought and an associated economic crisis. No one had any harvest to sell. It was a poor and sad life. Everyone in our town left, no one stayed in Manabí. People went to towns all over the country. We came here because we heard that there was water and a long rainy season. I had a brother who was already here, and he had constructed a house. We arrived with nothing because of the economic crisis, but we were happy. - Female Resident (7/1/2021)

After 1976, families from Manabí poured into the region as word spread of available cheap, or even free, fertile land with ample water access. Communication through familial and community networks led to a family-oriented pattern of settlement. Seven out of twelve households in the town of Aniceto shared the same family name and six out of twelve shared the same family name in the town of Descanso, for example. While colonist farmers were incentivized by IERAC to transform lush rainforest from “*tierra baldía*” into productive agricultural land, they also arrived with their own agri(culture). We use the term “agri(culture)” here to describe the collective cultural knowledge of campesinos whose cultivation capacity was passed down intergenerationally in Manabí and migrated to Parroquia de Cube with the settler population.

Our family is from Calceta, Manabi. My grandfather had a large finca there and so, my father bought cattle when he purchased land in 1980 in la Zona near Herrera [nearby town]. That is the business of our family, of our ancestors. My father moved our family here and now I have land and cattle of my own, following in the footsteps of my grandfathers. - Male resident (7/13/2021)

Some residents who have family origins in Manabí describe the imported agri(cultural) styles as destructive to the environment. There exists a general awareness of the connection between tree felling for agricultural expansion and the shortening of the rainy season.

They destroy. They are my people, but they destroy the environment. That is what happened in Manabí. It is totally dry over there now because they cut down all the trees. They do not care; they just log everything to cultivate their crops. They only envision the production of cacao and maíz and maybe some other cultivos as being useful. -Female resident (1/28/2022)

When we arrived [in 2003] there was pura lluvia, pura montana (read: lots of rain and lots of forest). Now there is not as much rain and there are more fincas (landholdings). When we arrived, there were three months of dry season, now it is more than half of the year. – Male Resident (7/17/2022)

The agri(culture) that came to Esmeraldas province with agrarian families from Manabí was multifaceted. On one hand, the population culturally identified as cattle ranchers. They arrived in Esmeraldas with excitement at the open and expansive horizons that this new land offered them in terms of growing their herds. On the other hand, the vivid experience of fleeing anthropogenic-induced drought was enduring. Farmers know well the vital importance of water access for irrigation of crops, livestock care, and household consumption. Many survey respondents reported leaving trees around their water sources to ensure volume and proper filtration for their fields and households.

4.2.3 Environmental governance tension

The REMACH was founded in order to protect essential Chocó ecosystems that provided habitats for a diversity of flora and fauna species, “benefiting local populations and the country” (Registro Oficial No. 29, 1996). Yet, in many research interactions, subjects did not communicate feeling that the reserve benefits them. On the contrary, they expressed injustice when they became aware that a reserve was being drawn directly on top of their landholdings:

In the 90s the government declared the land here a reserve. They flew over in helicopters to measure out lots and determine what land was to be allocated for the reserve and what land was people’s private property. I lost about 60ha of my land when that happened, and no one ever came to talk to me. There was a big protest that we organized when the

government officials came to put in the limits of the reserve. We blocked the few existing paths so that they couldn't get through. - Male resident (6/27/2021)

By 2003, the Ministry of the Environment (MAE) was authorized by the state to manage Ecuador's federally protected natural areas, including the REMACH (Registro Oficial Decreto Ejecutiva No. 3516, 2003). The only permissible activities inside the reserve were conservation, investigation, education, culture, recuperation, controlled recreation, and sustainable extraction (Registro Oficial No. 29, 1996, Art. 3). In interviews with key stakeholders, both MAE officials and resident farmers expressed that there exists a tension between local communities and MAE:

Honestly, the conservationists that we currently have [in the REMACH] are the three Chachi [local indigenous group] centers, the Afroecuadorian communities, and then a very low percentage of colonos, mestizo people. Many of them have deforested, similar to the case of Manabí where there are no trees in sight [...] we must also take into account that the generation who claimed land in the 60s and 70s preserved more than those who buy land now. Today, they cut down everything, without respect for the mountains. They even know that it is a reserve now and they still destroy the land. - Conversation between two officials from the Ministry of the Environment (7/12/2021)

We cannot register for an escritura [official land title] for our land now because it is inside of the Mache Chindul reserve. When we came from Manabí we received land through IERAC. It was part montaña [primary forest] and part rastrojo [regrowth]. We cleared the regrowth area to plant cacao, but we left the montaña as montaña. Now we are upset because at the time we did not know that our land would be inside of a reserve. I would prefer not to have land in the reserve. The ministry of the environment messed with us and did not tell the truth. - Male Resident (7/17/2021)

5. Discussion

5.1 Environmental sociology approach

The mixed-method political economy of the environment approach addresses gaps in the field of tropical rainforest conservation. Our work brings to light the most salient structural mechanisms – incentivized land clearing on the part of state-facilitated colonization, tension around land governance, a lack of viable economic alternatives due to the pressures of a

globalized and industrialized food system - that contribute to curiously high rates of deforestation in an Ecological Reserve despite federally protected status.

Archival work and historical literature review complement present day qualitative and quantitative data on land use and environmental politics, contributing to a robust and holistic explanation of tropical agriculture-driven deforestation. Our quantitative data describes the way that farmers use that cleared land today, and the energetic and financial investments that farmers continue to make to ensure food sufficiency and household well-being. The physical and psychological burdens of living in and attempting to transform the humid and dense tropical rainforest for survival purposes cannot be overlooked. The analytical approach responds to recent calls for better understanding the anthropogenic drivers of environmental degradation by identifying institutional and economic factors that shape Global South political ecologies (Dunlap and Brulle 2015; IPCC 2021; Osborne et al. 2021; Schipper et al. 2021).

Aside from the methodological approach, this research also contributes to the development of existing theories in environmental sociology. Road building is a central component of Rudel and Horowitz's (1993) sociological theory of tropical deforestation. In this case, the main highway was constructed to facilitate initial settlement of the area and aid commodity market expansion. The primary lead institution pre-1990 was IERAC, the state agency that promoted colonization. Growth coalitions of family networks in drought-ridden Manabí migrated and settled land together. Over time, supplemental feeder roads were constructed to transport agricultural product to market. Today, lead institutions such as public and private development banks provide financial loans to farmers for agricultural expansion and technological investment, resulting environmental degradation. Recent satellite images of the

region demonstrate a fragmented forest landscape where cacao fields line feeder roads and cattle pasture abound at the fringes of forest patches deeper into the REMACH reserve.

The smallholder colonist farmers in this case responded to economic opportunity in the form of available and accessible lands in Esmeraldas province. Upon arrival, many cleared large portions of land without the use of heavy machinery. Given the hardships that these individuals who migrated to Parroquia de Cube faced upon initial land settlement, we can understand why farmers capitalize on available agricultural commodity-related innovations, such as cacao *injerto* and supplemental chemical based agro-inputs, as the use of these technologies supposedly promises a return on the initial land clearing investment. Fenton (2020) discusses cacao capitalism, addressing the notions of productivity that underpin this classical narrative of agrarian industrialization and undermine socio-ecological well-being. Critics of industrialized agriculture name the human rights violations and environmental injustices that accompany technological innovations in the commodity-based agriculture sector (Leguizamón 2020; Patel 2008; Shiva 2016). Supporters of agrarian technologies, on the other hand, claim that the farmers who employ these technologies to increase commodity yields can accumulate capital while helping to “feed the world” (Sachs 2015). Farmers in this study were aware of the poor human and environmental health outcomes that result from use of chemical-based inputs and land clearing practices, yet they continue employing these production methods because they lack accessible economic alternatives and must survive. Eco-feminist scholar Vandana Shiva (2016) writes that establishing the primacy of productivity through the process of industrialization and privatization of land creates the social conditions for capitalist reorganization, promoting a society where technology—specifically biotechnology—is deeply embedded. Agrarian reform and colonization policy in Ecuador during the 1960-70s was characterized by incorporating

peasant farmers into capitalist markets and incentivizing the use of modernized agricultural technologies (Coral et al. 2021; Striffler 2002). These technologies, in tandem with policy, restructured the Latin American countryside to exploit its productive value (McMichael 2012). Today, farmers in Parroquia de Cube lack economic alternatives to agrarian industrialization.

The “Treadmill of Production” theory is another useful conceptual framework that explains the cycle of environmental degradation imposed by industrial agricultural practices. Technological innovation in the agrarian sector can keep farmers poor and agrarian ecologies depleted (Schnaiberg 1980). To maximize profit, farmers get hooked on agro-inputs that produce higher crop yields and can increase capital accumulation in the short term; but along with these agro-inputs comes several costly social and ecological externalities like drought and dispossession (Foster 2005). As cultivation mechanizes and further relies on technological innovation for high yields, more energy and/or chemicals are needed to replace earlier labor-intensive forms of agricultural production and further land commodification is needed to ensure the monetary benefits of technology investment (Gould, Pellow, and Schnaiberg 2004). The theory explains why farmers in Parroquia de Cube express longing, remorse, and uneasiness when they recollect arriving to the region to find *pura montaña*. Contextualizing land use decisions within a sociological political economy framework leads to empathy and the humanized rationalization of household-level decisions to clear forested land.

5.2 Varied environmentalisms

In the introduction of *Open Veins of Latin America* (1997) Eduardo Galeano writes, “Our defeat was always implicit in the victory of others; our wealth has always generated our poverty by nourishing the prosperity of others.” Ecuador’s development trajectory is unique given the

nation's high density of natural resources; extractive industry and conservation organizations alike have profound investment in the nation and in the Esmeraldas region specifically (Lewis 2016; Lopez et al. 2010; Riofrancos 2020). The 1980s and 90s introduced the harsh dilemma that the Ecuadorian state now finds itself in on a national scale, and regionally in the case of the Mache-Chindul reserve: how to satisfy both the demands of conservationists by protecting natural areas and simultaneously ensure the continued generation of national revenue, which historically relies on resource extraction?

The neoliberal 1990s, when the REMACH was founded, was a decade characterized by decentralization, privatization, and reallocation of social and ecological services responsibilities to the private sector (McMichael 2017). Following the 1992 UN Conference on the Environment and Development, funds from the Global North's government agencies and private foundations poured into the hands of Ecuador's private actors as structural adjustment programs like debt-for-nature swaps facilitated the establishment of biodiversity projects and protected areas like REMACH (Lewis 2016). Norman Myers (1988) naming of Ecuador's biodiversity hotspots was also influential. In his foundational piece Myers defined 'hotspots' based on their high species concentration, endemism, and degree of 'threat' (including from economic migration such as the case in Parroquia de Cube). Between 1990 and 1997 Ecuador received over \$96 million of foreign funding for ecological projects meant to protect the same ecosystems that decades earlier were tapped for colonization programs and agrarian reforms (i.e., deforestation and cash crop production.) (Lewis 2016).

Fundación Natura (FN) was the first nationally recognized private environmental organization in Ecuador. The NGO was founded in 1978 and is central to the emergence of the nation's organized environmentalism movement and to REMACH's beginnings. Shortly after its

founding, the organization received large grants from institutions such as USAID and international NGOs such as Conservation International (Lewis 2016). Campesinos living inside the boundaries of the Mache-chindul reserve expressed distress and confusion about their economic options given that the state first incentivized land-clearing through colonization and then shifted to pushing land-conservation with the founding of the REMACH. In our survey interactions we would often hear phrases like, “*No hay otras opciones*” (there are no other options). Residents are fully aware of how their land clearing practices contribute to environmental changes, which may be attributed to their collective experience fleeing anthropogenic climate change in Manabí. Yet they continue to clear land because they do not have economic alternatives where they live.

There are stark contrasts between environmentalisms deriving from the Global South versus the Global North with conflicting ideas about humanity’s role in nature being central to the divide (Esteva, Prakash, and Shiva 2014; Martinez-Alier 2002; Mies and Shiva 2014). FN received substantial support from powerful international environmental groups who shared a natural science approach to the environment (Lewis 2016). The organization embodied a Global North style of environmentalism that was about protecting biodiversity and species richness before ensuring social well-being for local communities. This model was clearly molded by foreign funding, a phenomenon that often occurs to social and ecological justice NGOs under the neoliberal non-profit industrial complex (Hale 2002; INCITE! 2007). FN and breakoff organizations, like Jatun Sacha, took a neoliberal view of the environment focusing entirely on “natural” ecological matters without concern for the human dimension of the conservation challenge. This is clear in the legislation that enacted the reserve, which asserts protecting endemic species benefits local populations without any socio-ecological follow up (Registro

Oficial No. 29, 1996). REMACH's founding was accompanied by a conservation model defined by elites who embodied a view of nature devoid of human contact, leaving the colonist farmers confused about their newfound role as agriculturalists whose fields were suddenly allocated for an Ecological Reserve (Lewis 2016; Smith 1999). Moving forward regional and local actors must overcome this view of human-nature relations to address the tension that both residents and officials from the Ministry of the Environment sense when interacting.

5.3 Implications for conservation interventions

The results of this study suggest that an inclusive community-engaged approach to conservation is optimal for addressing issues of equity and justice that drive forest loss. Identifying the structural sources of ecosystem degradation – incentivization from colonization programs, pressures from a global industrialized food system – is a key step towards meaningful and long-lasting ecosystems health. My scholarship addresses some of the root causes, not merely the symptoms, of forest loss and degradation. I address systemic barriers in the local (land tenure issues), national (land governance tension with the Ministry of the Environment), and international (increase yield to meet commodity market demands) arenas.

In the case of Parroquia de Cube, campesinos overwhelming express a lack of economic alternatives to the traditional cattle ranching and cacao production methods. They are aware of the negative environmental changes that occur following land clearing for agricultural expansion, but their connection to the global economy through financial investments in agrarian technologies accelerates the treadmill of production. Further research should investigate local knowledge and practices to empower representative local decision-making authority for sustainable futures. Based on the findings, agroecological production may be one suitable option.

The agricultural method emphasizes the use of locally resourced materials in agricultural production to preserve soil nutrient content and biodiversity (Copeland 2019). Colonist farmers may have imported land clearing practices in pursuit of pastureland, but they also imported a vital knowledge of how to maintain water in the ground and atmosphere so as not to induce regional drought once more. These two land-use knowledges – one industrial and monocultural, and the other agroecological - are at tension with each other. Scholars of environmental sociology typically utilize Marx’s theory of metabolic rift to discuss ecosystems services loss when industrial methods of agricultural production overpower agroecological ones (Clausen, Clark, and Longo 2015; Foster 1999). When landscapes are transformed in pursuit of efficient capitalist production, a rift in the socio-ecological relationship occurs. The capitalist and neoliberal policies implemented in Esmeraldas province, and in Ecuador more generally, directly shape the land use options for farmers today in Parroquia de Cube. Subsequent research on community narratives related to sustainable land use and local perceptions of political ecology could result in socio-ecological metabolic restoration in this important biodiversity hotspot.

6. Conclusions

By investigating the colonization programs aimed at Esmeraldas province, the ideologies and institutions that back the REMACH’s founding and management practices, and in describing how farmers productions methods are tied to a capitalist food system based on efficiency and productivity over socio-ecological well-being, we gain a better understanding of the context in which smallholder farmers decide to clear land for agricultural expansion. Rudel and Horowitz’s (1993) theory of tropical deforestation holds in the case of colonist farmers who clear land in and around the REMACH. This research addresses the nuanced complexity underlying the term,

“agriculture-driven deforestation,” which tends to provide overly generalized deforestation trends. I respond to the questions: what are the structural mechanisms that explain why smallholder farmers clear land? What are the sociological factors that contribute to high rates of deforestation in a federally protected Ecological Reserve? By embedding present day land use decisions in a socio-political web, this study frames Parroquia de Cube’s farmers as individuals who make rational decisions based on the economic options available to them. The methodological approach alleviates some of the blaming of farmers by identifying lead institutions, in addition to the growth coalition of famers, as actors in the story of tropical rainforest degradation in the area. This environmental sociology approach to conservation is applicable beyond REMACH’s boundaries and is useful for broadening our understanding of pressing environmental problems.

Appendix A. Survey Instrument

This is our structured survey that covered land use practices and decisions, family origins, and income, quality of life, and assets. We did ask additional questions, but the ones included here directly produced this publication.

IDENTIFICACIÓN y HISTORIA FAMILIAR

Comunidad:

Apellidos de la cabeza de familia:

La relación de la persona entrevistada al jefe de hogar:

esposa esposo abuelo hijo

¿Cuales los niveles de educación y edades de los jefes de hogar?

¿En qué año llegó su familia a esta zona?

¿De dónde vino su familia?

¿Por qué abandonaron su lugar de origen?

¿Cómo era la tierra en su lugar de origen?

¿Quién le habló de la posibilidad de mudarse a esta región?

¿Por qué usted o su familia eligieron venir aquí y no otra región?

¿Cómo era la tierra cuando usted o su familia llegaron aquí?

¿Hace cuánto compró inicialmente su tierra?

¿Cómo ha cambiado el paisaje en el tiempo que usted ha vivido aquí?

¿Cómo ha cambiado el clima en el tiempo que usted ha vivido aquí?

PARCELA

¿Cuánta tierra total posee usted, incluyendo todas sus fincas?

¿Tienen ustedes una escritura o papales legales para su finca?

¿La tierra era tumbada cuando la compró? ¿Cuántas hectáreas han tumbado desde adquisición?

De la tierra que usted posee, ¿cuál es el área en hectáreas que utiliza para pastos? ¿Para el cacao?

¿Para otros productos?

¿Cuánto de la tierra que posee es bosque? ¿Sabe usted si es bosque *secundario* o *primario*?

Si tiene usted tierras forestales, ¿por qué dejó los árboles?

INGRESOS

Si usted produce cacao, ¿cuál es su cosecha anual?

¿Qué tipo de cacao produce?

¿Utilizan un fertilizante con base de productos químicos en su cacao? Para que? Precio?

¿Tienes algo más sembrado entre su cacao? (policultivo o monocultivo)

¿Dónde vende su cacao? ¿Cómo se llega allí?

Si tiene pasto, ¿tiene *vacas cárnicas* o *lecheras*?

¿Cuántas vacas totales tienes?

¿Cuánta leche cosechan cada semana? ¿Hacen queso? ¿Lo venden?

¿Cuánto ingreso total obtiene cada año de su ganado después de los gastos o los costos de producción?

¿Producen otros cultivos?

- Si es así, ¿cuánto dinero ganan anualmente en los otros cultivos?
- ¿Tiene alguna otra fuente de ingresos?
 - ¿Tiene algún préstamo o crédito formal?
 - ¿Tienes una cuenta bancaria?

COSTO DE VIDA

- ¿Cuánto gasta la familia en comida para la familia cada semana?
- ¿Qué alimentos necesitan comprar?
- ¿Qué alimentos cultivan en su tierra?
- ¿Tienen suficiente comida? Menos? Mas que suficiente?
- ¿Alguien en la familia tiene una enfermedad crónica?
- ¿Qué utilizan para necesidades de transporte?

CALIDAD de AGUA

- ¿Dónde consiguen agua?
- Si compran agua, ¿cuánto gastan en agua cada mes?
- Si tienen un pozo, ¿cuál es la distancia entre el pozo y la casa?
- ¿Cómo se lleva el agua de vuelta a la casa?

CONCIENCIA AMBIENTAL

- ¿Cree que la deforestación es un problema en la zona? ¿Por qué o por qué no?
- Si la tierra se secura aquí, ¿a dónde irías? ¿Qué harías por sus ingresos?
- ¿Cómo quiere que sea la tierra para los hijos y generaciones futuros?

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Biography

Liat Perlin is a community engaged environmental sociologist who is passionate about action research. With training in participatory methods gained through her service with the Peace Corps in Guatemala and through her academic career, Liat is equipped to serve as a solidarity interlocutor, a scholar with the capacity to respectfully bridge local struggles for environmental justice with globalized discourse in an effort to induce social change.