The Political Ecology of Wildfires, at the Intersection of Climate Change and Landscape

A case study of rural Tuscany, Italy

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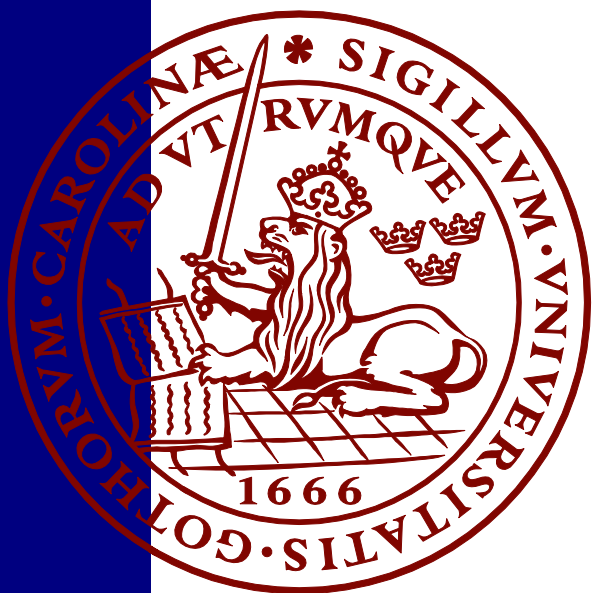

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Abstract:

Wildfires are a climate change indicator whose increasing activity poses a threat to biodiversity and to ecosystem and human wellbeing. In the Mediterranean region, examination of the foundational drivers of intensifying wildfire regimes is necessary for the identification of sustainable wildfire mitigation measures. Literature review, semi-structured interviews, and focus group interviews with local municipal actors in wildfire mitigation are employed via a mixed-methods approach in this case study which examines the foundational, socioeconomic drivers of wildfires in Tuscany, Italy. A political ecology lens is applied to understand the modern Tuscan landscape as having been formed by historical interactions among power structures and political and market developments and conditions. Results demonstrate that while Tuscany is climatically predisposed to wildfire activity, historical processes of industrialization and commercialization have rendered the land more vulnerable to destruction by wildfire. Historically-informed and community-based approaches are recommended for sustainable wildfire prevention and mitigation.

Keywords: wildfire, landscape mosaic, political ecology, Tuscany, community-based solutions

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Table of Contents

1. **Introduction and Background**

1. 1 Mediterranean Wildfires and Risk

Formerly considered to be a dangerous force that destroys or severely damages any environment it enters, an expanded perception of fire by fire ecologists now understands it to be a profoundly influential, even evolutionary, process that brings about varied and far-reaching consequences (McLauchlan et al., 2020). In fact, Pausas and Keeley (2009) assert that it is impossible to conceive of the world as it exists today without fire, as it is an ecosystem process with evolutionary consequences that permeates the history of life on Earth. Throughout this history, fire has interacted with and impacted both climate and biota, contributing to aerosol emissions, altering the ecosystem functions of carbon sequestration and nutrient cycling, and impacting biodiversity and species size (Lavorel et al., 2006; McLauchlan et al., 2020; Pausas & Keeley, 2009). Fires therefore have intricate and changing relationships with climate and ecology, impacting the two and being impacted in turn, in ways that vary depending on the climatic and vegetal characteristics at hand (Lavorel et al., 2006).

In addition, humans have harnessed fire for more than 400,000 years, using it to manipulate our environments for some 40,000 years, resulting in intricate and long-enduring human-fire-environment relationships (Ascoli, 2007). This history and these relationships vary among and within regions. Within the Mediterranean Basin, humans have used fire as a tool in land modification and agropastoral activities starting towards the end of the Pleistocene epoch, which ended over 11,000 years ago (Ascoli, 2007; Johnson, 2023; Syphard et al., 2009). Throughout the years, humans have used fire to open travel passageways, drive wild animals to be hunted, transform forested areas into grassland or pasture for agricultural production, and clear land for cattle grazing (Ascoli, 2007).

Wildfire, conversely and more specifically, refers to “any uncontrolled vegetation fire which requires a decision or action regarding suppression,” including in forested areas (Stacey, 2012). Wildfires can only occur under specific conditions of temperature, humidity, and the moisture content of fuel, which is “any material that can support combustion,” and may include “trees, shrubs, grasses, and forest debris,” including biomass and necromass (*Wildfire Climate Connection*, 2022; Stacey, 2012). Wildfires are thus a climate change indicator, as climate change has created warmer, drier climatic conditions that are conducive to intensified wildfire activity and prolonged wildfire seasons (*Climate Change Indicators: Wildfires*, 2023; *Wildfire Climate Connection*, 2022). Wildfires

are increasingly dangerous, and are considered to be a threat to biodiversity, ecosystem and human health, and security (Dube, 2009; Lozano et al., 2016; *Climate Change Indicators: Wildfires*, 2023).

Considering the effects of climate change as a globally-driven, globally-present phenomenon on a local scale is a key characteristic of what sustainability science seeks to explain (Kates et al., 2001). This climate-driven threat is especially pressing in the southern European Mediterranean region, whose climate is already characterized by hot, dry summers and cool winters, where an increase in fire occurrence and area burned is anticipated alongside an increase in droughts and heat waves (Briens & Garavaglia, 2013; Lozano et al., 2016; Syphard et al., 2009). Additionally, Mediterranean climate ecosystems contain some of the richest biodiversity in the world, hosting over 25,000 plant species compared to 6,000 species for central and northern Europe. Wildfires are of course a vital threat to this biodiversity (Briens & Garavaglia, 2013). The vegetal makeup of the Mediterranean lends itself to wildfire risk as well, dominated by evergreen shrubs that are highly flammable and support the development of crown fires, which occur when fire consumes, either intermittently or in a sustained manner as a "wall of flame," the upper foliage of vegetation (Stacey, 2012; Syphard et al., 2009).

Additionally, there is a profound human impact upon wildfire regimes, which describe the pattern of frequency, size, and intensity of fires (Stacey, 2012). Human population, presence, and activity, through manipulation of and dependence upon local environments, contribute to heightened wildfire risk in a myriad of ways (Dube, 2009; Syphard et al, 2009). Because increased wildfire activity in the Mediterranean is tied to local socioeconomic conditions (i.e. high poverty and unemployment levels), changing settlement patterns that induce landscape transformations (i.e. abandonment of marginal rural areas, urbanization, and expansion of rural-urban interfaces (RUIs)), and changes in land use (i.e. shrub encroachment, the abandonment of grazing practices, and intensive agricultural cropping systems), the socio-ecological conditions upon which wildfire regimes operate is fundamentally tied to human activity (Briens & Garavaglia, 2013; Carlucci et al., 2019; Ferrara et al., 2019; Michetti & Pinar, 2018).

There is consequently an essential human role in addressing, mitigating, and preventing wildfires. Because wildfire regimes in forested areas can be explained in part by the institutional arrangements that not only manage forests but the resources necessary to fight forest fires, the response and adaptation of governance systems to increasing fire activity and risk will become all the more important (Michetti & Pinar, 2018; Lozano et al., 2016). This heightened risk will demand thorough strategic planning regarding the uncertain, changing, and increasingly extreme nature of wildfires in the Mediterranean, and the development of engaged and informed wildfire mitigation and suppression approaches. Therefore, local forest management and governance systems who find

themselves tasked with this responsibility must be comprehensive and adaptive (Briens & Garavaglia, 2013). Research in this field must involve a holistic approach characteristic of sustainability science, one that involves various forms of knowledge and the participation of scientists and citizens alike. This way, "scientific exploration" and "practical application" can continually influence and inform one another (Kates et al., 2001, pp. 1). Moreover, the complexity of all environment-society interactions in Tuscany does not only serve to enrich the narrative presented in this project, but serves as a necessary component of the problem-driven sustainability science movement as it aims to address these complex interactions in the creation of more sustainable futures (Clark & Dickson, 2003).

1.2 The Case- Background

Of the most popularly known regions of Italy is Tuscany, situated to the center-north of the country and comprising a resident population of 3,663,191 as of 2022 (*Istituto nazionale di statistica*). Its landscape has been formed over centuries by agricultural practices carried out through distinct landowner-worker relationships, resulting in the production of cereals, olives, and wine, in addition to pastoral practices and the rearing of cattle, pigs, and poultry (*Britannica*, 2023b; Gaggio, 2018). The celebrity of the Tuscan landscape draws tourists to such an extent that in spite of the socioeconomic diversity of the internal, hilly area of Tuscany (that which is generally considered to be the "Tuscan countryside"), the local industry of both the urbanized, productive settlements and the rural, depopulated areas is dominated by tourism (*Rapporto sul Tursimo in Toscana*, 2021).

The historical developments leading to the emergence of new industries in Tuscany, and the landscape changes that occurred as a result, are essential to understanding the socioeconomic and topographical setting of modern wildfire regime behavior. Over the course of several decades following World War II, the mountainous and agricultural areas of rural Tuscany underwent a mass "exodus" led by and coupled with the introduction of new industries to the region (Agnoletti & Santoro, 2018; Gaggio, 2018). In the two decades leading up to 1970, 40% of Tuscany's formerly productive agricultural land fell completely or partially into disuse with the loss of two-thirds of the agricultural workforce and the general abandonment of pastoral lifestyles (Gaggio, 2018; Piras et al., 2021). Meanwhile, both funding and local labor went into the development of the blossoming rural tourism industry, centered on wine production and consumption (Gaggio, 2018). Those areas still dedicated to agriculture witnessed the replacement of a traditional agricultural production method that involved agroforestry and intercropping with intensive,"highly capitalized" monocropping (Ferrario, 2021, Gaggio, 2018). These population and livelihood shifts, coupled with agricultural transformations, resulted in the loss of the traditional, complex, highly biodiverse "mosaic" landscape that characterized the Tuscan countryside. Consequently, with the end of the integration

of forests in agropastoral practices, unmanaged forests began to recolonize these abandoned spaces, fallen to disuse (Agnoletti, 2007; Piras et al., 2021). The abandonment of rural areas, the simplification of the mosaic structure, and the neglect and regrowth of forested areas all increase the landscape's vulnerability to wildfire (Bertomeu et al., 2022; Carlucci et al., 2019; Gaggio, 2018; Lasanta et al., 2022).

Today, Tuscany is the most forested region of Italy. After being reforested at a rate of 2500 hectares of new forest per year from 1954 to 2016, 53% of the Tuscan landscape is now forested. These forested areas are decreasingly correlated to those dedicated to pastoral and agricultural activities, with 30% of all forests existing as the result of farmland abandonment (Agnoletti & Santoro, 2018; Piras et al., 2021). Additionally, the tourism industry is overwhelmingly present in rural areas, with its dominance becoming all the more emphasized in recent years. Between 1997 and 2012, the rural Tuscan economy experienced an increase attributable mainly to the rise of agrotourism, with a 380% increase in rural farmhouse accommodations between 1997 and 2014 (Agnoletti & Santoro, 2018). Meanwhile, wildfires have become increasingly prevalent. From 2000-2017, Tuscany experienced a yearly average of 459 wildfires, with notably high numbers in 2003, 2012, and 2017 (*Piano AIB 2019-2021,* 2019). Remarkably, in the first six months of 2022, three times the amount of hectares burned than in 2021 (*Toscana in fumo…*, 2022). After the first nine months, Tuscany experienced a total of 591 forest fires, which surpassed the average of the previous 7 years by 56%, and a total of 2,247 hectares of forested areas were consumed by flames (*Incendi, il 2022 anno…,* n.d.).

The aforementioned need for a comprehensive approach to forest management and wildfire prevention and mitigation, informed by a historical understanding of the natural ecological role of fire and its use in landscape management by humans, is therefore pressing in Tuscany. Effective wildfire prevention is dependent upon the direct involvement of local people in agricultural and forestry activities, including the employment of traditional methods of landscape management not yet lost, in order to ensure sustainable rural development and robust adaptation to wildfire risk (Bertomeu et al., 2022; Briens & Garavaglia, 2013). This paper thus explores, in addition to the drivers and impacts of wildfires, the role of local, community-based wildfire prevention and mitigation in Tuscany.

1.3 Research questions

The research questions (RQs) are as follows:

RQ1: What are the historical drivers of wildfires in Tuscany?

Addressing this question involves an exploration of the historical processes that shaped the current Tuscan landscape and how its current form renders it vulnerable to wildfires.

RQ2: How do local approaches in wildfire mitigation respond to these drivers and to the socioeconomic and ecological consequences of wildfires?
Addressing this question involves an exploration of local approaches to wildfire mitigation and assessment, including how researchers and officials relate wildfire regimes to climate change.

Cross-cutting these themes is the continual centering of a core focus of sustainability science: how interactions between nature and society are shaped by long-enduring environmental and developmental trends. Concerns of landscape transformation, population shifts, increasing vulnerability for ecosystems and the livelihoods upon which they depend are therefore centered in understanding the main drivers and consequences of wildfires (Kates et al., 2011).

2 Theoretical approach

The purpose of this section is to detail this paper's theoretical approach, determined by Political Ecology (PE). It both describes and defines PE and provides an overview of the key facets of PE that are used in data analysis and in addressing both RQs.

2.1 Political ecology approach to wildfires

Robbins (2012) writes that PE, more than a theory or a framework in-and-of-itself, is more-so a body of scholarship which comprises various schools of thought in order to provide explanations for the (sometimes surprising) outcomes of cases, for which many other theories may provide insufficient explanation. PE owes its success in providing these explanations to the demand that applying this approach requires consideration of the foundational and structural causes and drivers of a phenomenon or case, and that this consideration must include the influence of political economic forces. PE is informed by Marxist conceptualizations of the political economy, which are based in the precepts that 1) environmental degradation is fundamental to capitalism, in that capitalist production requires the overextraction of natural resources, and 2) that the social relationships that determine how food and goods are produced drive societal change and form the basis of social and cultural systems. PE thus entails analysis and exploration of the dynamics of power, including considerations of the ways by which and by whom power is wielded, how these dynamics drive historical processes of development or of degradation, and how the ecosystem or landscape upon which these processes play out is constructed and reconstructed. PE is also concerned with the translation of research to practical application, aiming to apply an understanding of the underlying drivers of a (socioeconomic, ecological, or otherwise) issue to the formation of its (sustainable) solution (Peet et al., 2011; Robbins, 2012).

In order to understand wildfires in Tuscany, consideration of ecology must be wedded to that of the historical and changing nature of the local political economy. This provides a contextual understanding not only to the creation of the landscape, but to how its current form renders it vulnerable to wildfire destruction. This is the process of analysis which constitutes the "hatchet" of PE: the effort to describe existing socioeconomic and ecological conditions not as natural or as inevitable, but rather as the "contingent outcomes of power," resulting from political and market developments and conditions. In this process, the consequences of and the purposes served by presenting the landscape as "natural," in spite of its inherent existence as human-made, are explored (Robbins, 2012). Perspectives of power and narratives of degradation are therefore necessary to understand environmental and socioeconomic change in historical Tuscany, and to explore the ways by which they historically have been entangled in a process of capitalizing the Tuscan landscape,

marginalizing its residents, and degrading its environment. PE has already proven to be a useful framework for approaching both landscape transformation and wildfire activity. Because a landscape's significance is tied to its function, its transformation presents an opportunity to analyze how landscapes become the setting of consumption and investment, at some actors' hands and at others' expense, and how this transformation represents changes in production and in everyday life (Connolly, 2022). Additionally, wildfires' activity along the landscape is understood not only as a response to the changes that various competing actors effect in their environment, but as an uncontrollable force of nature that cannot be dominated by humans (González-Hidalgo et al., 2014).

2.1.1 Perspectives of power

When applying theories of power in PE, it is recommended to use a range of power perspectives and to situate these perspectives within local sites. This offers greater understanding of both the relations between actors and of the formation of power relations, especially as they interact with local and global influences (Svarstad et al., 2018). The perspectives applied here are actor-oriented and neo-Marxist.

Actor-oriented power perspectives stress that power, rather than being a force that passes between people or through communities unnoticed, is exercised by actors through the use of power resources. "Power resources" refers to the tools that may be wielded by an actor to realize their goals and effect change on their surroundings, and may take the form of various types of capital, including: class position, finances, and, most relevant to this case, land (Svarstad et al., 2018). In Tuscany, this allows insight to the processes by which land-owning actors, powerful as such, drove production.

However, there are structural aspects underlying the ways by which power resources are obtained and wielded. A neo-Marxist power perspective, which stresses that social structures constrain human agency, therefore supplements an actor-oriented perspective. While power resources are owned and used by actors, their ability to both obtain and use those resources is subject to the capitalist social relations surrounding them. It is not, therefore, only access to and possession of power resources, but societal social conditions as well which determine the power that an individual may possess (Svarstad et al., 2018). Understanding the processes by which capitalist social relations are created, and how people are enveloped into these relations, requires consideration of the aforementioned role that social relationships play, as they determine how goods are produced, in forming the basis of these social systems (Hall, 2013).

In this case, powerful actors are historically considered to be landowners, as they are able to effect change on their environment, and the state, as it grants subsidies for the promotion of certain industries.

2.1.2 Narrative of degradation and marginalization

Rather than universally applicable theory, the PE narrative of degradation and marginalization provides an analytical framework, which, on par with PE as a whole, contextualizes environmental degradation in its broader political and economic setting (Robbins, 2012). This narrative does not aim to prove again what commonly occurs, that environmental degradation and marginalization of human populations go hand-in-hand; rather, it stresses that systems of production which are otherwise environmentally non-destructive, once having been exposed to development initiatives by the state or integrated into local or global markets, become overexploitative of natural resources (Robbins, 2012). Once enveloped into markets, systems of production, driven by competition among capitalists and characterized by (natural) resource-intensive methods, obscure the social and environmental consequences of production through price systems which signal only the "labor content and capital investment" of commodities (Peet et al., 2011, pp. 14).

In this case, degradation is defined as any landscape condition which renders it more vulnerable to the start of wildfire, and a decreased ability of the landscape to slow or stop the propagation of wildfire, under the condition that these changes occurred as a result of human interference. Categorizations of the landscape as pre- and post-degradation, are not meant to imply a transformation from a natural to a man-made state; rather, the role of changing population and human activity are considered essential to shaping the landscape in any of its forms.

2.1.3 The "seed" of PE

Robbins (2012) outlines what is, in my opinion, the most appealing characteristic of a PE-based theoretical approach: that it allows for the emergence of more sustainable solutions to unjust and disastrous conditions, accomplished through social collectivity and solidarity. This constitutes the "seed" of PE: the description of the ways by which the social and political transformation necessary to skirt ecological collapse on a global scale, and ensure sustainable and just livelihoods and wellbeing on the local, may be realized. This envisioning and outlining of solutions to crises, replacing cynicism with optimism, is understood as a necessary and possible means to creating more equitable and sustainable futures.

PE is therefore an extremely suitable approach to the study of the phenomenon of wildfires on the Tuscan landscape, as it explores the capacity of collaborative work among various stakeholders with various forms and bases of knowledge to envision and create socioeconomically

and ecologically sustainable solutions. It also tests Robbin's claim that during catastrophe, people act out of a new and refreshed sense of solidarity.

3. Methodology: A case study explored via mixed methods

The purpose of this section is to outline the methods by which I 1) collected the data necessary to address the RQs and 2) applied the theoretical framework described in the previous section in order to analyze the data. Data are collected via a mixed methods approach, involving secondary data collected via a narrative literature review, and primary data collected via interviews and field note collection. Justifications are included for my choice of data, their application, and their presentation in the form of a case study.

3.1 Wildfires in Tuscany- a Case Study

This project presents research on the phenomenon of wildfires in Tuscany in the form of a case study, which is designed through a process of interpretation, reflection, and selection (Lund, 2014; Tellis, 1997). Research is undertaken in this manner so as to create what Rohlfing (2012) refers to as a "case-centered" case study, which aims to offer an explanation of this phenomenon without an attempt to generalize, creating this explanation by instrumentalizing theory. In this case, my theoretical approach of political ecology requires analysis of the ecological and socioeconomic conditions surrounding wildfires in Tuscany through an understanding of historical land and resource use (Crowe et al., 2011; Turner, 2016). This is done in an effort to clarify the deeper causes underlying wildfires over their symptoms by considering wider contextual processes beyond the data themselves (Flyvberg, 2006; Lund, 2014). Therefore, in the construction of an organized, presentable case study, I focus attention on dynamics of ownership, knowledge, and solidarity surrounding both the drivers and consequences of wildfires in Tuscany and the responses to those wildfires. These dynamics are privileged in PE-based research, as they situate wildfires within the setting of the Tuscan landscape, understood to have been formed as a result of historical changes in material conditions and social relations (Lund, 2014; Robbins, 2012).

The goal is to construct a unique narrative which not only provides an understanding of wildfires as a climate change indicator, but explores the broader phenomenon of landscape transformation as induced by socioeconomic changes and outlines the implications of wildfires as they pertain to social and ecological sustainability (Flyvbjerg, 2006). Reflection as to whether data collected and included in the case study are relevant to those dynamics noted above is necessary throughout this construction process. Data is then sought out and included on this selective basis (Tellis, 1997). Ultimately, the observable phenomenon of wildfires in Tuscany can be understood in a nuanced way (Flyvbjerg, 2006).

3.1.1 Secondary data collection: Narrative literature review

The first method of data collection is a narrative review of literature relevant to the case. This review serves the purpose of building a comprehensive, foundational understanding of traditional landscape management techniques in Tuscany, historical changes in Tuscan economy and livelihoods, how those changes have manifested themselves in the landscape, and how wildfire regimes have responded to these landscape changes. This specific literature review is unsystematized, yet data was not sought out in a careless manner; rather, sources were evaluated based on their ability both to contribute to the construction of the aforementioned PE-based historical narrative, and to contextualize and supplement the data collected in interviews (Green et al., 2006; Miles et al., 2020). Instead of a more systematic approach, which may have concealed new and insightful information from me through an incompletely informed scope defined by strict inclusion and exclusion criteria, I searched through an inductive, exploratory process which adapted as my familiarity in the subject matter increased (Green et al, 2006; Greenhalgh et al., 2018).

22 peer-reviewed articles are used in providing background information and in building the historical context of landscape change and wildfire vulnerability. I additionally reviewed 11 pieces of gray literature, which comprised local wildfire reports. Sources were reviewed in English and Italian languages. I searched for academic sources in the Google Scholar and in the Lund University library, LUBSearch, databases in order to cover a wider breadth of source material (Green et al., 2006). Broader searches, combining phrases such as “forest management,” “Tuscany,” and “wildfires,” were conducted in order to build a preliminary understanding of the subject matter. Past the initial, exploratory phase of research, however, more specific searches were conducted in order to gather more case-specific information, including, for example, that which pertains to the connection between the end of historical sharecropping agreements and landscape changes in Tuscany. Gray literature included mostly Italian-language, local sources, from news media organizations such as Firenze Today and Lucca Indiretta. In sum, these peer-reviewed studies and local news reports were used in the building of a literature review which aims to 1) summarize information known about historical socioeconomic and landscape changes, traditional and modern landscape management practices, and wildfire regimes, including the ways by which wildfires respond to and are driven by these changes, 2) serve as a baseline from which I can supplement the knowledge from this literature review with that gained from interviews, and 3) either corroborate or contradict the literature review findings, strengthening my results or provoking further investigation (Bowen, 2009; Greenhalgh et al., 2018).

3.1.2 Primary data collection: Semi-structured and focus group interviews

In addition to a literature review, I conducted semi-structured and focus group (FG) interviews in English and Italian languages. In some of the Italian-language interviews, a translator (with a comprehensive understanding of fire ecology) clarified linguistic misunderstandings and provided help when needed, especially in light of the local Florentine dialect. My semi-structured interviews were conducted with the following actors:

Table 1: List of actors with whom individual interviews were conducted

Interview date(s) *(MM/DD/YY)*	Organization/affiliation	Role
2/10/23	University of Turin	Researcher in forest ecology and management, fire risk management
2/14/2023 3/29/2023	D.R.E.A.M. Italia	Expert in training firefighting and wildfire prevention methods, coordinator of land management projects
2/17/23	Municipality of Massarosa	Councilor of civil protection and specialist in local agricultural and production activities and historical memory
3/16/23	N/A	Local (area of Montegiano, Province of Lucca, Municipality of Massarosa) volunteer in wildfire fighting and response
3/23/23	Regione Toscana	Manager of activities relevant to rural and agricultural development (accompanied by AIB actors listed below)
3/23/23	N/A	Resident of Calci (Province of Pisa)'s Firewise Community (accompanied by AIB actors listed below)

My FG interviews were conducted with the following actors:

Table 2: List of actors with whom focus group discussions were held

Interview date(s) *(MM/DD/YY)*	Organization/affiliation	Roles
2/16/23 2/23/23 3/9/23 3/23/23 4/6/23	Antincendi Boschivi (Regione Toscana)	English language associate Regional director of forest fire prevention, prediction, and fighting; AIB planning and programming

		(2) Operatives of forest fire risk management, forest management, climate change adaptation intervention, wildfire response action and post-fire environmental evaluation
3/16/23	Municipality of Massarosa, N/A	Local residents of Massarosa municipality Director of community forest fire prevention and awareness activity (accompanied by AIB actors listed above)

These interviews provide invaluable information in understanding the PE of wildfires in Tuscany because of both the localized and the expert knowledge of the interviewees. All interviewees have lived experience in Tuscany, especially in rural areas, making them intimately familiar with concepts essential to a PE-based study, including knowledge of the ecological makeup of the local environment and social knowledge of traditional institutions, cultural dynamics, and local heritage (Robbins, 2012). I chose these interviewees not only because they are the ones to whom I had access and who were available for interview, but because of their localized knowledge and expertise in fire ecology; they all have (and most, to a great extent) a certain level of understanding of historical and current fire behavior along the landscape. Interviewing experts has great research advantages, especially in the exploratory phases of my research, including: providing relatively more efficient and informative data than, for example, participatory observation, offering this data in a short time-span, and, in my experience, offering opportunities for greater access into the field (Bogner et al., 2009). To allow for flexibility in the interviews and the opportunity to be enlightened by interviewees of unanticipated and relevant information, I approached each interview with a semi-structured list of questions, including, for example, the following questions:

- In which ways is landscape change a component of fire risk?
- In which ways are rural, forested, or agricultural areas at risk of destruction by wildfire?
- How have the local climate, landscape, and wildfire regimes changed in recent years? Which of these changes have you personally witnessed?
- What are some of the cultural or socioeconomic barriers to wildfire prevention?
- What are your personal experiences with wildfire response and firefighting?

Each interview was open-ended to allow for the aforementioned flexibility and shifts of focus within relevant subject areas. This is true as well for the FG discussions; while I came prepared with some specific questions, my role was really that of a discussion facilitator. The group with which I met was composed of researchers within the regional governmental organization Antincendi Boschivi (AIB), which works meticulously to predict, prevent, and suppress forest fires in the region's forested,

agricultural, and residential areas, through a foundational understanding of the driving processes behind these fires. Regarding the aforementioned benefit of gaining greater access to the field through expert interviews, I was able to accompany this group of researchers to two rural sites impacted by forest fires in recent years, Massarosa (Province of Lucca) and Calci (Province of Pisa) to discuss the emotional, ecological, and socioeconomic impacts of the wildfires, and the communities' efforts to prevent future fires.

Interview data referenced in this paper is cited in the format (INT, *date*), with the date written in MM/DD/YY format.

3.2 Reflections and reflexivity

The two methods listed above each require ongoing processes of reflexivity in collecting and analyzing data (Green et al., 2006; Olmos-Vega et al., 2022). Reflexivity takes many forms, and becomes meaningful to this project not through active attempts on my part to approach data in a subjective manner, or by simply acknowledging that my experiences, expectations, and personal convictions inform both the questions asked and my understanding of the responses; rather, reflexivity requires that I evaluate the ways by which my subjectivity influences each stage of the research process (Olmos-Vega et al., 2022). My methods of reflexivity are inspired by Olmos-Vega et al. (2022), and include a consideration of my methods which entails an understanding both of the ways by which my theoretical framework of choice imposes boundaries upon my research, and of my reasoning behind choosing this framework. For example, due to my personal conviction that global mechanics of capitalism drive change on a local scale, I not only find PE to be a suitable and interesting framework for approaching my RQs, but I also find it relevant to include (if briefly) information regarding the ways by which the USAmerican-led global effort to capitalize systems of production impacted Tuscany. The inclusion of this information is probably also informed by my finding it interesting as a USAmerican.

Another necessary reflection concerns the ways by which familiarity and appreciation color my relationships with interviewees, the information provided by interviewees, and my understanding of that information (Olmos-Vega et al., 2022). In this project, repeated meetings with the same FG, as listed in Table 2, complement the semi-structured interviews listed in Table 1. Through these meetings, I was able to build the necessary familiar relationships and foundations of trust with the interviewees, allowing for the disclosure of more personal information and the opportunity to fully appreciate the unique knowledge disclosed to me (Guest et al., 2017; Olmos-Vega et al., 2022). These relationships proved invaluable both to receiving insider insight, especially as my status as an outsider was concretized by my not being Italian, let alone Tuscan, and to providing opportunities for

clarification of my understanding of interviewees' points of view, ensuring that I understood their positions correctly (Nader, 1972; Olmos-Vega et al., 2022). As the conductor of this research project, I ultimately determine what is and is not considered useful information; therefore, this recognition and appreciation of interviewees' knowledge is a necessary part of reflexivity (Olmos-Vega et al., 2022). Additionally, in following O'Reilley (2012)'s guide on the ethnographic process of collecting data in the forms of photographs and field notes, I participated in what Olmos-Vega et al. (2022) refer to as "reflexive writing," which, through recording reflections, makes the noting of my perspectives intentional.

In sum, through a process of reflexivity, both openness regarding my interests and motives and acceptance of the value of the insight provided to me were prioritized, ultimately creating a necessary relationship of candor and trust between interviewees and myself.

3.3 Qualitative Data Analysis

This section focuses on the ways by which I made sense of the qualitative data collected, as informed by Miles et al. (2020). This process entails assigning codes to my field notes and interview notes and transcripts, reflecting on commonalities and differences in the data within the same theme (i.e. fire prevention factors, fire risk factors, etc.), and finally drawing conclusions about the data by compiling overarching trends and reflecting on those findings by comparing them to what was to be theoretically expected.

Some steps are necessary to prepare the data for coding and analysis. For unrecorded interviews, I edited the notes that I had taken throughout the interview so as to clarify and contextualize what was said for later reference. For recorded interviews, I transcribed the audio files with the transcription service Sonix, then edited and corrected the transcription while listening back to interview audio or footage. Then, for interviews held in Italian, I translated the transcription into English using the translation service Reverso, then reviewed the transcript, correcting any linguistic or translation errors. While I kept the interviewee's name in the transcript, I ensured anonymity by ascribing a number to each interviewee, as seen in Table 1. My transcripts were then ready to be coded. For this, I used the Computer Assisted Qualitative Data Analysis Software (CAQDAS) NVivo, which allows for the storage and maintenance of data before it is coded (Miles et al., 2020).

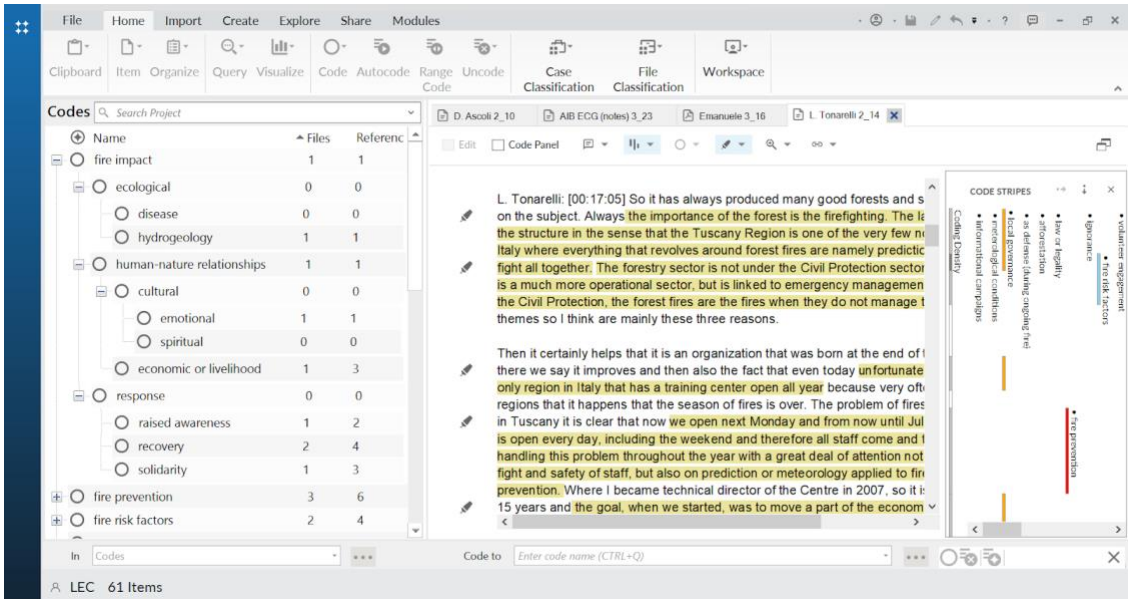


Figure 1: My screenshot demonstrating the NVivo coding process. To the left is a preview of the codes used to organize the data; to the right is a preview of an interview transcription, with coding strips highlighted in order to show the codes corresponding to certain sections of the transcript.

Miles et al. (2020) define codes as "labels that assign symbolic meaning to the descriptive or inferential information compiled during a study" (pp. 62). Coding, therefore, is the process of data exploration and organization that allows the researcher to develop familiarity with the data. My codes are mainly concept codes (referring to broader phenomena, such as landscape mosaic loss), value codes (referring to attitudes or beliefs, such as conviction in personal responsibility to protect one's home from wildfire damage), and emotional codes (i.e., a local being moved to tears as he tells me about his deep, personal connection to the area) (Miles et al., 2020). My codes also incorporate themes important to PE, allowing me to highlight themes of ownership, power, and solidarity. While PE plays an essential role in informing the codes initially, it is also used in comparing the generalizations created post-coding to theoretical expectations. The comparison of these generalizations generated in the coding process to theoretical expectations, much like that of interview and field work data to literature review findings, inspires either the strengthening of results or the provocation of further investigation. This way, the function of PE in the expectations prior to analysis of the data and in the analysis itself is not to restrict the scope of what is considered; rather, it is a helpful guide and a point of reference for analysis (Crowe et al., 2011).

4. Results and Discussion

4.1 RQ1: Historic landscape change and increased wildfire risk in Tuscany

This section provides a background to the historical drivers of wildfires in Tuscany. As mentioned above, population and livelihood shifts in Tuscany following the Second World War led to the replacement of the traditional and complex landscape mosaic, built by traditional agroforestry practices, with unmanaged forests and expansive vineyards. This has entailed substantial consequences for the landscape in terms of sustainability, biodiversity, and wildfire activity (Agnoletti, 2007; Gaggio, 2018; Piras et al., 2021). It begins by contextualizing the end of agroforestry practices within the broader processes of commercialization that unfolded in the decades following the Second World War, understanding this landscape change as occurring both alongside and as a result of the political and economic changes that this commercialization entailed. The loss of the mosaic landscape as a result of rural abandonment was repeatedly referenced throughout interviews with leading Tuscan researchers in wildfire mitigation as having profound impact on wildfire regimes in the region today. The conditions surrounding this abandonment and the concurrent landscape transformation therefore merit exploration.

4.1.1 Market initiation, the end of agroforestry, and rural abandonment

In the decades following the end of the Second World War, Tuscany shifted from a subsistence-based to a market-oriented economy (Gaggio, 2018). Throughout and following this process of "capitalist restructuring," some socioeconomic features of Tuscany remained more-or-less the same, while those of the landscape and local populations were drastically transformed. Of the features that remained mostly unchanged is the dualistic structure of both class and property size (Gaggio, 2018).

Following the collapse of the sharecropping economy, the survival of private property rights entailed the survival of the two (albeit coarse) classes, the property-less and the propertied (Hall, 2013; Gaggio, 2018). Sharecropping (*mezzandria classica)* describes a specific relationship between people and land, wherein landowners provide the provisions (capital) necessary for agricultural production (including land, food, and housing), while peasants work the land in a form of tenancy, repaying landowner for the capital provided with their labor and with the fruits of that labor (Britannica, n.d.a; Gaggio, 2018). Organized in this manner, peasants formerly maintained the landscape mosaic by practicing a form of agroforestry. Agroforestry is a traditional intercropping practice that creates an extremely complex agricultural landscape through the cultivation of more than one crop in the same field, including that of trees and shrubs, while integrating pastoralist animal husbandry (Damianidis et al., 2020; Ferrario, 2021). In Tuscany, this type of agricultural

production, known as *agricoltura promiscua,* was carried on for centuries, predating the Roman era, where it was documented, before blossoming and expanding throughout this time and throughout the Middle Ages, finally reaching a crescendo in the 18th century before its demise in the market economy. It is nearly impossible to understate the intricacy and minute detailing of this production system; various elements grew to different heights in the same space, in time with their own rhythms. Grasses, trees (including, among others: elm, ash, and walnut trees, providing timber, and olive, mulberry, cherry, peach, and apple trees, providing fruits), in addition to cereals and legumes, flowers, and maize, dotted and lined the field. Pastoral transhumance in the mountainous areas further enhanced the biocultural diversity of the landscape, bringing about interaction between livestock and the aforementioned elements, especially the forests, as livestock foraged along the forest floors. Additionally dependent on the forests of the mosaic was that which differentiated Italian landscape mosaics from other traditional agroforestry systems and made it uniquely rich and complex: the grapevine, which was considered to be "married to the tree" (Ferrario, 2021, para. 13; Gaggio, 2018). In the particularly mountainous Tuscan region of Chianti, winemaking had been practiced for centuries in this fashion, cultivated in rows that were interspersed with cereals and fruits (Gaggio, 2018). This meticulous and careful production system was extremely labor-intensive; its maintenance therefore required great amounts of manpower and depended on high human density that was provided by sharecropping, as the landowner provided housing for (typically multigenerational) peasant families (Ferrario, 2021; Gaggio, 2018).

The process of capitalist restructuring, taking place in the latter half of the 20th century, brought about the collapse of sharecropping and of *agricoltura promiscua*. During this time, drastic changes in Tuscany's population and methods of agricultural production transformed the landscape so significantly that it was rendered unrecognizable to its former self. As the area shifted from a subsistence-based to a market-oriented economy, rural Tuscany, which was once defined by a rich and diverse landscape, now was defined by newly-prioritized industries: grape monocropping, tourism, and, to a lesser extent, pine forest planting. In all of this, ultimately, landscape came to assume "the features of a vast vineyard interrupted by woods" (Gaggio, 2018; INT, 3/23/23).

The "dualistic structure of property" remained relatively the same following Tuscany's economic transition; properties were either very small or very large (Gaggio, 2018, pp. 113). By 1970, less than 2% of farms still made up 35% of the land, while 77% of farms made up 19% of the land. This means that during these transformative decades, a very small population of landowners, with control over vast amounts of land, were able to capitalize on the land in whichever way they thought most lucrative. In this setting, local landlords seemed to take to heart the claims of a rural economist: that wine production deserved the greatest public investment as it was the key to profit in the area

(Gaggio, 2018). *Agricoltura promiscua* was thus subjected to systematic delegitimization and economic devaluation, replaced by specialized, unvaried agricultural production. In comparison to foreign, capitalistic agricultural production, *agricoltura promiscua* was accused of irrationality. Introduced to Tuscany then was a more modern, industrial agriculture that mechanized production, necessitating fewer hands to tend the field and separating crops that were once cultivated in concert (Ferrario, 2021). In *The Shaping of Tuscany*, Gaggio (2018) describes the coinciding, consequential shift of population decline in the agricultural and mountainous areas of Tuscany. The countryside, providing space for specialized vineyards that cultivated the "Chianti Classico"- branded wine demanded by American markets, "seemed to accrue value only insofar as its population dwindled and its traditional activities were abandoned" (Gaggio, 2018, pp. 154). Therefore, the years between 1951 and 1968 witnessed a population decrease of nearly 40 percent, with the 1960's characterized by the abandonment of more than 6,000 hectares of previously cultivated land. In Siena, older vineyards were widely neglected while vine monocropping increased its area by more than double between 1929 and 1969. By 1970, the landscape of the Sienese area of Chianti was composed of 2,949 hectares of specialized vineyards, relative to 142 hectares 1957; meanwhile, those hectares dedicated to *agricoltura promiscua* decreased by 40% (Gaggio, 2018). In the 1970's *agricoltura promiscua* had nearly disappeared from the Italian peninsula, and by the 1980's, agroforestry had reached "vestigial" status (Ferrario, 2021; Gaggio, 2018). With open spaces formerly managed by the practice of pastoral transhumance, the exodus of rural populations allowed for the overgrowth of unmanaged forest areas (INT, 2/10, 2/14/23; Piras et al., 2021). The Tuscan forests which were once an essential part of the local economy and agricultural activity were almost entirely devalued, and after the Second World War, pine forest planting intensified to produce paper and other goods. This led to a high and unbalanced ratio of pine species, particularly *pinus pinaster* to other tree species, especially broadleaved trees, including elm and oak species (INT, 3/23/23; Piras et al., 2021). Additionally, the 1970's saw public funding nearly entirely dedicated to the development of industries "that ran counter to widely shared commitments, such as the revitalization of agriculture" (Gaggio, 2018, pp. 155). These funds went largely to the construction of buildings to accommodate tourists. Locals noted with shock the transformation of the formerly decrepit and mouse-infested homes in which peasants lived into tourist accommodations while community settlements disappeared (Gaggio, 2018)

While the Tuscan landscape came to manifest the desires of local landowners and serve the needs of the emergent industries, this was not a process that unfolded without protest; it occurred at the defeat of a peasant movement in a political and class strife between peasants and landowners strife in the region (Gaggio, 2018). Italy's reception of an aid package from the U.S. following the

Second World War, which aimed to rebuild the nation in the image of "American-style capitalist development," undoubtedly colored this struggle. In funneling millions of dollars into anti-leftist efforts and threatening to withdraw aid in the case of a communist victory, communists lost bids for national power (Bevins, 2020). While leftist organizers held strongholds in Tuscany in spite of this effort, trying desperately to hold on to the area's thinning population, perhaps by "recapitalizing traditional agriculture" and bemoaning that the aforementioned public investment to agricultural specialization was enriching large landowners, their efforts were stomped out as rural Tuscany became the site of national and international actors involved in the sale and purchase of agricultural land (Gaggio, 2018).

In sum, following a process of capitalist restructuring, the prioritization of emergent viticultural and tourism industries was justified in the pursuit of profit. Today, as Tuscany faces an unprecedented level of wildfire activity, these historical changes have put the region at increased risk of wildfires in a myriad of ways, as the problems that Tuscany currently faces in wildfire prevention result from the unification of problems that have arisen since Tuscany's rural exodus in the previous century, including the loss of the landscape mosaic that this entailed. The following section explores the ways by which these factors contribute to modern wildfire risk; but first, the socioeconomic and ecological transformations described above are briefly discussed in light of PE.

4.1.2 Discussion: An entanglement of power dynamics and degradation, wildfires as a political phenomenon

While previous subsections present definitions of the main PE concepts used in this project separately, this is not to say that, in application and analysis, one can be divorced from another. In the changes that took place throughout historical Tuscany, dynamics of power cannot be separated from those of marginalization, nor can those of degradation be separated from those of production; rather, all aforementioned concepts are closely entwined, continually influencing and reinforcing one another. All concepts are necessary in understanding the ways by which structural economic change allowed some actors to accumulate capital and power, while disempowering others, and provides insight to the processes by which land-owning actors, powerful as such, drove production engendering landscape change.

Today, the Tuscan landscape presents the features of the industries that have come to dominate it since the region's initiation to a market economy, rather than those that indicate agroforestry practices. Of course, it is not simply the development of intensive monocropping itself that is to blame for Tusany's increased fire activity, but rather what this development represents: the loss of the landscape mosaic caused by rural abandonment. There is no use in trying to determine to

what extent rural abandonment was a driver or a result of industrialization and capitalist restructuring; Gaggio (2018, pp. 148) writes that the debate "relies on a dichotomy of coercion and choice that is utterly unrealistic." What matters is that this process of capitalization was both the "cause and effect" of the aforementioned abandonment of peasants from the rural agricultural and mountainous areas of Tuscany, and that these changes entailed the replacement of traditional agroforestry practices in a way that had direct effects on the landscape (Gaggio, 2018, pp. 130). Therefore, it was a change in the organization of labor that signaled a transition to resource-intensive and ecologically degrading methods of agricultural production. This coincides with the Marxist claim that resource-intensive methods of production arise not from technological advancements, but from changing social relations (Peet, 2011). It was therefore *not* the mechanization of agricultural production, but the establishment of new organizations of labor that fundamentally reshaped the rural Tuscan landscape. This transformation elucidated the ways by which envelopment of a production system into markets shapes possible action, as motives for profit, or merely for sustenance, are entwined with wider power relations. As this rural abandonment and the collapse of *agricoltura promiscua*, alongside climate change, have impacted modern wildfire activity in a manner that is impossible to understate, wildfires, while a climate change indicator, are expressly *not* an apolitical phenomenon (INT, 2/10, 2/14, 2/16, 3/9, 3/16/23). This means that there is a distinct role of governance in wildfires mitigation, as political drivers call for political responses.

4.2 RQ2: Tuscan wildfires today, their consequences and mitigation

This section focuses on the local Tuscan firefighting and prevention efforts in the face of increasing wildfire risk. As established, Tuscany is expressly at greater risk of wildfire activity because of the loss of the landscape mosaic. The frequency of wildfire outbreak is lower in agroforestry areas because landscape mosaic maintenance both 1) manages the forests by incorporating it into production, and 2) in preventing fuel accumulation, provides firebreaks which can prevent the start of fire and slow its progression (Damianidis et al., 2020). The replacement of mosaic landscapes by unmanaged forests spells out disaster for Tuscany, as forests are more combustible than mosaic landscapes and have a lesser capacity to suppress fires (Lasanta et al., 2022). Silvicultural methods of stopping the spread of wildfire, such as pruning trees and clearing the undergrowth of forests (in order to prevent fires from spreading horizontally across the landscape or vertically in formation of a crown fire), are becoming decreasingly effective in the face of intensified wildfire regimes (Bertomeu et al., 2022). Conversely, in the context of a changing climate, which puts additional pressure on the Mediterranean landscape, mosaic landscapes have a "fire regulatory effect" (INT, 2/10/23). Therefore, as agroforestry historically has contributed to the development of landscape mosaics, this

practice has been promoted in rural areas for their ability to slow the spread of wildfire and reduce fire risk substantially (Bertomeu et al., 2022; Damianidis et al., 2020; Lasanta, 2022).

Based on a series of interviews with actors within the Tuscan Region's municipal government organization Antincendi Boschivi (AIB), data indicate that ongoing wildfire prevention efforts in Tuscany mimic, and build upon, the services formerly provided by agroforestry practices. Municipal approaches to wildfire management incorporate, alongside forest management, that which characterizes mosaic landscape: the reduction of biomass in addressing fuel accumulation and the involvement of local, rural communities in land management. This section provides an overview of the ways by which increasing wildfire activity is confronted, as it addresses both the climatic and socioeconomic drivers and the consequences of wildfire activity in Tuscany in profiling Massarosa, a rural Tuscan municipality of Italy impacted by wildfires during July of 2022.

4.2.1 Wildfire in Massarosa, experience

Massarosa is a rural municipality located within the Province of Lucca, whose beauty makes it a sought-after tourist destination in spite of its relatively sparsely populated local community. The municipality is composed of 16 different fractions, some of which have more consolidated populations than others (INT, 2/17, 3/16/23). Cultivations mainly include olivries, although grapes and cereal crops are cultivated as well (INT, 2/17/23). The area is widely forested, and the forest which spans the landscape is composed of a majority of pine trees, some oaks, and acacia trees (INT, 3/16/23). A local community organizer and leader described to me the landscape's former appearance as something of a homogenous panorama of greenery, with some areas dedicated to cultivations in terraces, and the rest forested (INT, 3/16/23). When I traveled through Massarosa in the spring of 2023, however, the verdant hills were replaced by what appeared to be a colony of matchsticks; the landscape was brown with trees stripped of all of their leaves.

This traumatized landscape reflected the impact of a wildfire that Massarosa endured in July of 2022, the most destructive of hundreds of wildfires that affected Tuscany that summer. Of the previously mentioned 2,247 hectares that burned, 918 of those hectares burned in one major wildfire in Massarosa, which began between the night of July 18th and the morning of the 19th from under a highway overpass near the small town of Bozzano (INT, 3/16/23; Roscoe, 2022). Massarosa's famous forested hills were torched alongside those areas cultivating olives and grapes, threatening farms dedicated to agrotourism as well, causing approximately 1,000 tourists and residents alike to flee their residences, hundreds of which in the middle of the night (*Il fuoco divora…*, 2022; *Incendio Massarosa: sopralluogo…*, 2022; *Massarosa, 800 ettari…*, 2022). The shock and horror that residents experienced are accounted for in their testimonies of emotional distress. One resident recalls waking

up early in the morning of the 19th to see a low wall of fire creeping across the landscape, not sleeping for the following two nights, stating "I was worried, because I knew what was all around: dryness, the heat, the wind…" (INT, 3/16/23). In all, the sensory stimulus of the wildfire was all-encompassing, as residents saw a red horizon, felt its heat, and heard the sound of exploding pipes and pine cones (INT, 3/16/23). While homes were destroyed, fortunately no one was killed (INT, 3/16/23, *Massarosa, 800 ettari…*, 2022). The impact of this experience on the locals with whom I spoke left one with a feeling of fear in her own home, and left another with tears in his eyes as he described his emotional connection to an environment destroyed by fire (INT, 3/16/23). A disaster that caused so much destruction and pain merits active, organized responses in the form of preventative measures. These responses have been informed by the causes of this fire and ones like it.

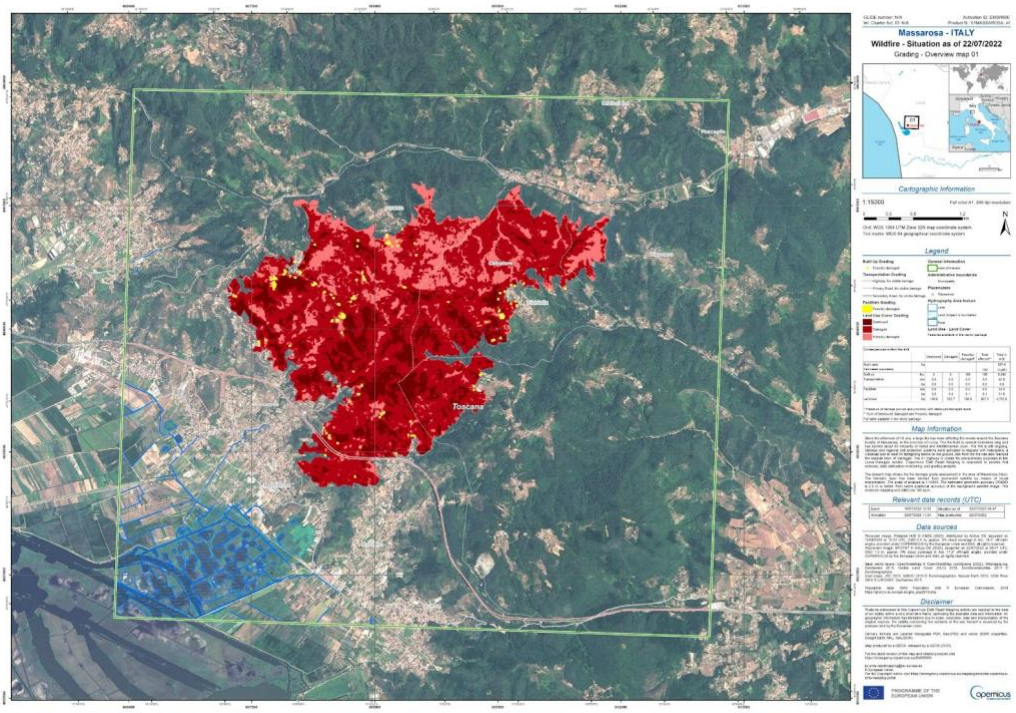


Figure 2: A topographical view of the fire in Massarosa, rendered 4 days after the start of the fire. Image taken from https://emergency.copernicus.eu/mapping/ems-product-component/EMSR600_AOI01_GRA_PRODUCT_r1_RTP01/1.

4.2.2 Today's wildfire causes and triggers

What specifically incited this wildfire has little to do with that which informs future preventative and suppression efforts. When I asked what sparked the fire, I was met with the guess that it could possibly have been caused by a cigarette tossed from the overpass (INT, 3/16/23). This matter is relatively unimportant; what has been prioritized are efforts to address Tuscany's

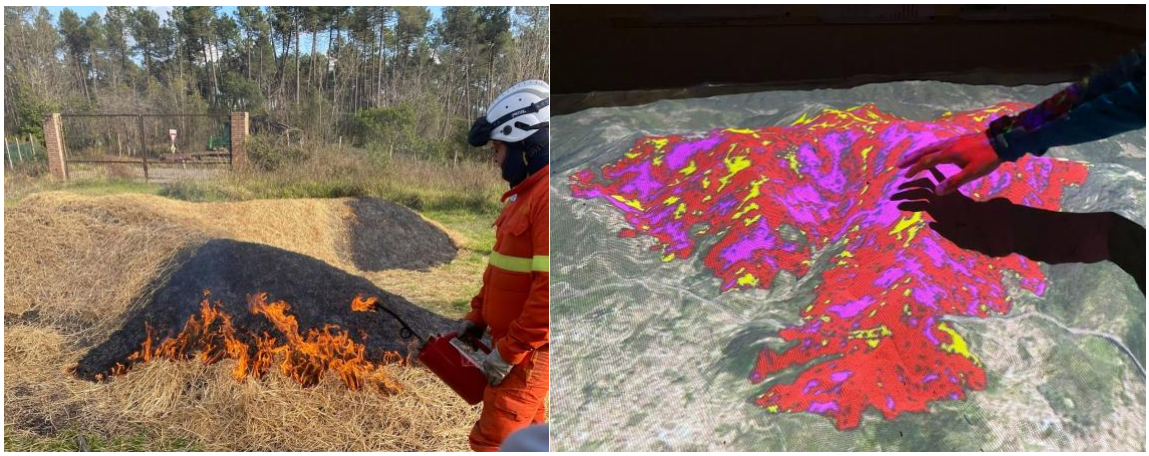
responses to climate change and to remedy the effects of absent land management, rather than campaigns to stop people from haphazardly throwing cigarettes out of their car windows. However, this is not to say that citizen engagement campaigns to prevent fires have not been employed or effective in either prevention or protection against wildfires. Rather, community engagement in the forms of volunteer involvement and educational programs has proven to be essential in effective firefighting and prevention in Tuscany, but more on this later.

One driver of this particular fire was certainly climate change. High temperatures, low humidity, and scarce rainfall characterized Tuscany's hottest and driest year on record and put pressure on the efforts of AIB (*Il fuoco divora*…, 2022; *Incendi, il anno 2022…,* n.d.; *Record di caldo*…, 2023). In 2022, Tuscany was 1.3 °C hotter than the average between 1991 and 2020 (*Record di caldo*…, 2023). These conditions together with wind have contributed to the creation of suitable conditions for wildfire outbreak, especially as they dry out vegetation (INT, 2/24, 2/16, 3/16/23). Climate change is not a driver in-and-of itself; rather, it compounds the aforementioned wildfire risk factors. It has now become the "new normal" to have wildfire outbreaks under this combination of landscape characteristics and the pressures of climate change (INT, 2/10/23). In fact, a leading coordinator with AIB confirms that wildfire risk lies only on one hand in climate change, and on another hand in insufficient forest management leading to the accumulation of fuel along the forest floor, encroaching flammable shrubs (which are among the first to populate an abandoned area), a high concentration of equally flammable pine trees, and disease (INT, 2/10, 2/16/23). Pine trees dominate local forests as a result of both their being intentionally planted in decades past for timber, and their ability to grow in the poor soil that characterizes some areas of Massarosa (INT, 2/10/23). Wildfires, pine trees, and disease interact in a reinforcing manner; when infected with a certain disease, pines emit highly flammable resin which amplifies the effect of the wildfire. Additionally, when subjected to fire, pine cones explode and spread their seeds, helping the plant to reproduce. There are then natural mechanisms that make the Tuscan landscape vulnerable to wildfire for which it is difficult for humans to respond (INT, 3/9/23). Today, Tuscan forests are described as "jungles," whose overgrowth is directly attributed to the abandonment of farmlands and the farmhands who used to tend them (*Il fuoco divora*…, 2022). Interviewees attribute the propagation of the 2022 wildfire in Massarosa both to convection, charting its pathway from one direction until its redirection by winds from the sea, and to the lack of landscape management in conjunction with local meteorological conditions under climate change (INT, 2/10, 3/16/23). In sum, all of these conditions made the wildfire difficult to control, to the point that its power and quick progression was such that a local official in wildfire suppression stated that, for the first time in his career, he was unsure of what to do. All conditions together culminated to create a "perfect storm" (INT, 3/16/23).

4.2.3 Firefighting efforts and challenges

This section describes some of the current efforts to prevent and suppress wildfires in Tuscany, along with the moments of miscommunication and logistical difficulty and those of cohesion and solidarity which characterized the days following the outbreak of the June 18th wildfire.

Part of what differentiates Tuscany's efforts to prevent and fight wildfires is consideration of the historical use of fire (INT, 2/10/23). Fire is intentionally applied to the landscape to serve the purposes of preventing, containing, stabilizing, and extinguishing wildfires (INT, 2/24, 3/29/23). The reduction of fuel is accomplished by burning biomass and necromass through a process of prescribed burning (PB), which directly addresses a function formerly performed by agroforestry practices, and in this instance, reduces fuel so as to make wildfires less likely (Ascoli, 2007). As mentioned in the introduction, the application of fire in landscape management has a long-enduring history in Europe, yet PB's use in attaining landscape management goals in accordance with planned operational procedures is practiced minimally in Italy, especially in comparison to other Mediterranean European countries (Ascoli, 2007; Ascoli & Bovio, 2013; INT, 2/10/23). This is due in part to cultural reservations surrounding the practice and to the vast extent to which Tuscan forested land is privately owned, requiring landowners' participation in the PB process (Ascoli & Bovio, 2013). Today, 80% of forested areas in Tuscany are privately owned, while the single largest forest owner is the Tuscan regional government (Agnoletti & Santoro, 2018). In any case, the training for fire application is being performed in a collaborative environment, centered at La Pineta, which is Tuscany's only training center focused on the use of PB and applied fire in both preventing and fighting fires (*Field Work Notes from Italy*, 2022). The center aims to build a fuller understanding of fire dynamics in a collaborative effort involving AIB, volunteer actors, and other firefighting forces through simulations involving various meteorological and topographical conditions of wind, terrain slope, and others (INT, 3/29/23).



Figures 3 & 4: A demonstration of applying fire so as to manage wildfire's propagation. Right: A 3-dimensional depiction of the spread of the 2022 Massarosa fire. Both images were taken by me at La Pineta.

Additionally, the municipality works to prevent wildfires and to protect citizens through engagement and collaboration with the local community. Part of this effort is to educate citizens on the aforementioned difference between wildfires as a dangerous and uncontrolled force, and fire as an ecological force and possible tool (INT, 2/10/23). Part of what this entails is building a popular understanding of fire as a "natural element" that serves ecological functions and can be harnessed to enhance human activity in a culture that widely associates fire with hell and destruction. For some, this realization has been eye-opening in building a comprehension of fire's many functions (INT, 2/10, 4/6/23). Additionally employed by municipal leaders in coordination with AIB are educational campaigns, even engaging children, that inform locals about wildfire risk and safety measures. The role of employing photos, videos, brochures, and pamphlets is ultimately to raise risk awareness (INT, 2/17, 3/16/23). This may help to address the cultural hesitation to embrace PB as a preventative measure. Additionally, in endeavors such as these, the individual's role in protecting the self and property have become emphasized, especially in the development of Firewise Communities (FWCs). FWCs in Italy take their inspiration from a similar program in the United States, and aim to involve citizens in self-protection against wildfires by engaging those who live in an RUI in a series of protocols with the help of local officials. This involves the development of defensive spaces and protective fire barriers between a home and a forest through process of "cleaning" the land and trees (i.e., employing the aforementioned silvicultural approaches in addition to the removal of pine needles and shrubs from around a home) (*Firewise- Comunità antincendi…,* 2023; INT, 2/16, 3/23/23). The ultimate goal is to make citizens safer within their homes in the case of a wildfire, as, due to failing road infrastructure, evacuation is not always possible. (INT, 3/16, 3/23/23)

Here, challenges in firefighting in Tuscany become apparent. Some of the challenges in addressing Massarosa's 2022 wildfire demonstrate the linkages between insufficient infrastructure

and strained communication. Reaching the villages in the Apennine mountains entailed driving up winding, narrow, steeply-inclined roads, lined on either side by burnt trees. Interviewees noted the inaccessible nature of the terrain, characterized by a morphology that was very difficult to navigate. In some areas, local populations were easier to access because they were more consolidated; however, others lived in scattered homes across the territory (INT, 3/16/23). Additionally, in these RUIs, the issue of development and connectivity extends beyond that of missing or underdeveloped physical infrastructure. An interviewee with AIB noted that the stark disparity of development in the rural areas in comparison to that of the urban areas is exemplified in the lack of technological services. There is no cell service, and workers rely on radio rather than cell connection. This is another difficulty in accessing people in times of danger (INT, 3/29/23). Communication was made increasingly difficult by Massarosa's popularity as a tourist destination, as Massarosa accommodates 30,000 tourists yearly, in comparison to the local population of 21,000 (INT, 2/17/23). In addition to the threat that tourists pose in possible ignition of wildfires by simply partaking in human activities, (i.e. lighting barbecues, setting off fireworks), communication with tourists is strained simply by the language barrier (INT, 2/14/23). In emergency situations, this makes it very difficult to convey the gravity and danger of the situation at hand and to manage the tourists in an evacuation, as fear and confusion can cause chaos. This was highly problematic during the outbreak of the fire in Massarosa, as many of the tourists were German and could not speak Italian, and many of the local Italian firefighting operatives and volunteers could not speak English (INT, 2/14, 3/16/23). Additionally, issues of connection are compounded by property dynamics, which connects these issues to those of land vulnerability. As a legacy of the former days of agroforestry and capitalist restructuring, many privately owned, formerly agriculturally productive properties comprise the Tuscan landscape. Since falling into disuse and abandonment, these properties are not only full of unmanaged and flammable vegetation, but, according to one interviewee, have owners who are disconnected from the property physically and emotionally. This makes it difficult to access those owners, who may or may not be at the property at the time of the fire, let alone to encourage them, or provide to them the resources necessary, to better manage their property in order to reduce wildfire vulnerability (INT, 3/16/23).

4.2.4 Discussion: What to do? Traditional landscape management and community for modern wildfire prevention

Many interviewees would like to see broader governance changes enacted to ensure more effective wildfire prevention. Among the challenges to firefighting listed above is that of management; this problem does not only apply to this specific wildfire, but refers to the broader issues of forest and agricultural management in Tuscany. According to one AIB operative, FWCs and

other efforts emphasizing personal responsibility in protecting one's self and one's home are only a small part of the solution, and the individual's personal role should not be emphasized in this matter. Rather, he emphasized, and many others echoed, changes in factors of governance and legislation are necessary to effectively approach issues of forest and agricultural land management (INT, 2/10, 3/23, 3/29/23). This may also fortify Tuscany's integrative approach to forest fires which involves not only fighting, but prediction and prevention as well (INT, 2/14/23).

However, the prioritization of prevention is a financially burdensome request. When I mentioned to a local firefighting volunteer that the consensus among experts seems to be that wildfire prevention ought to be prioritized over suppression, his response was to remind me of Italy's extremely high public debt (INT, 3/16/23). Another interviewee insisted that it is impossible for public administrative bodies to ensure the protection of local forests and communities, as it would take millions upon millions of euros to scratch the surface of the problem (INT, 3/16/23). As tourism only contributes to 7% of the Tuscan economy, it does not seem that the income from this industry can be allocated in such a way as to benefit the local community in a substantial way (Agnoletti & Santoro, 2018). At the same time, as a great increase in the Tuscan rural economy between 1997 and 2012 has been attributable to the increasing popularity of agrotourism and accommodation in rural farmhouses, the landscape and its resources remain commodified for consumption by tourists, and forest management remains related to the touristic use of the landscape (Agnoletti & Santoro, 2018; INT, 2/16/23).

Nevertheless, at its core, wildfire prevention really refers to structural forest management efforts (INT, 2/14/23). Perhaps for this reason, a local director of firefighting training stressed that a goal of his organization's efforts was to lobby the regional government to move part of their funds from investing in active fighting to prevention (INT, 2/14/23). However, in light of increasing wildfire activity, increasing investment in Italy has been given to resources necessary for the suppression of active wildfires, rather than to land planning. This means that wildfires are treated as less of a land management problem than they are a matter of civil protection (Ascoli & Bovio, 2013). In Tuscany, civil protection efforts lie within AIB's organizational efforts, so that prevention is a part of the civil protection efforts that address forest fire fighting. In other regions, the forestry sector manages wildfire prevention efforts. This is quite ironic, considering Tuscany is one of Italy's two most forested regions (INT, 4/6/23). Greater education of the fact that once a fire has begun, human efforts to stop its progression are as futile as those to stop rainfall has been suggested as a means to transfer investment from fire suppression to prevention (INT, 2/10/23).

However, there may be other, less financially-intensive means of protecting local communities and nature from wildfires in the most fundamental, and universally-comprehended way

possible: prioritizing the management of forested and agricultural land. Some interviewees expressed a need for a legal effort which would see local law consistent with land management and ecosystem needs, attributing rights and regulations to people in the management of their land and forests (INT, 3/23/23). This may help to reconcile the injustice lying both in the making of local Tuscan production systems less sustainable for the sake of profit and the power associated with it, and in the failure to reconcile the vulnerability to wildfire caused by the transformation of those production systems and the landscape itself. For example, this may entail the permission and training of locals to practice PB, or allow its practice by officials, on their land. This is now prohibited, as it is unregulated and therefore causes wildfires, yet it is still practiced secretly by some shepherds and farmers, who find themselves having to perform a necessary, yet illegal, practice (INT, 2/10, 2/14/23). In reality, the application of fire to the landscape today is a relic of Tuscany's former agroforestry and landscape mosaic maintenance practices (INT, 2/10/ 23). This type of legislation may recall a cultural memory not fully lost, as it is not too long ago that one interviewee recalls her father applying fire for the management of their rural property (INT, 4/6/23). Perhaps, if agroforestry practices reduced the Tuscan landscape's vulnerability to wildfires, then allowing and regulating a component of those practices could bolster preventative efforts in wildfire activity today.

These factors emphasize the need for a wildfire management approach that engages all citizens, so as to ensure safety during a wildfire which overburdens the municipality's resources. If there are any silver linings to disasters such as that which affected Massarosa, they include a raised popular awareness of wildfire risk, and a new sense of community in ensuring mutual protection (INT, 2/16, 3/16/23). As one resident described it, paradoxically, the local community was united during the disaster. Prior to the outbreak, distances between properties contributed to a missing sense of community in the rural areas of Massarosa, yet many interviewees expressed that a strong sense of solidarity among residents materialized out of the realization that the situation was severe. Upon this realization, locals offered food and accommodation for those evacuated, while agrotourism sites gave hospitality for free (*Incendio Massarosa: sopralluogo…*, 2022; INT, 2/17, 3/16/23). As the spirit of community care seemed to spread everywhere, this provided an opportunity for the community to build off of this sense of solidarity to create a community organization focusing on lobbying for improved and repaired infrastructure, and educational campaigns for risk awareness (3/16/23). The opportunity for collaboration and community engagement that experiences such as this present, along with an understanding of the historical drivers of wildfires, inspire the methods employed by AIB to prevent wildfires and to protect communities and forests in the occurrence of an outbreak. For AIB, a community-based approach to wildfire prevention has only been enacted for the past few years as a result of study and training, yet

these factors together are what make Tuscany, in comparison to other regions of Italy, the most successful in preventing and managing fire (INT, 2/10, 4/6/23).

5. Reflections and Conclusions

The changing and volatile nature of climate change requires the continual examination and reexamination of the implications of the damages incurred by wildfires and of efforts to mitigate these damages, yet my time as a researcher has been limited. This is therefore not a comprehensive account of landscape transformation, nor can it be, nor does it pretend to be. Tuscany's history is notoriously rich, and in simply trying to chart the basics of a few decades' worth of socioeconomic and ecological change, I found myself trying to make sense of an extremely intricate web of actors, intentions, and impacts. So, in this attempt at charting Tuscany's history in a streamlined and cohesive manner, I can only hope that what I present is at least minimally reflective of the region's complexity. In recounting the efforts of forest fire fighting and preventative action, I attempted to sufficiently elucidate the care and insight that goes into the work which interviewees have referred to as "the passion of my life" (INT, 4/6/23). Hopefully, this project shines a light onto a fraction of the insight that was revealed to me throughout this research process.

In sum, this project explores the historical causes, impacts, and current prevention and mitigation efforts of wildfires in Tuscany. Political ecology is used to understand Tuscany's historical landscape transformations as resulting from the actions of the powerful, and to explore the ways by which the landscape has consequently become vulnerable to wildfires. A combination of shifting market and management factors engendered such a change in the Tuscan landscape that it no longer, or scarcely, resembles its pre-transformation form. The vineyards of the Tuscan landscape, which are perhaps its most emblematic and identifying feature, have come to be popularly considered to be a natural trait of the landscape and a relic of a long-enduring cultural heritage. In fact, their existence, and their enjoyment by tourists, represents the replacement of a former complex and traditional land management practice. It is impossible to truly know the extent to which the loss of this landscape contributes to current wildfire vulnerability, as so many factors, from land degradation, to rural poverty and disenfranchisement, to climate change contribute to Tuscany's increase in wildfire activity. However, what can be promoted now are possible avenues to enhance, and fortify those already existing, the efforts to manage and protect the Tuscan landscape and its inhabitants. Here, the "seed" of political ecology emphasizes the importance and necessity of developing a means to sustainable and effective wildfire prevention. Currently, efforts entail the practice of prescribed burning on a limited and managed scale, educational campaigns to raise wildfire risk awareness, and training in firefighting and preventative efforts. In the future, these efforts may include the legislative integration of ecological and wildfire prevention needs, and the re-introduction of components of former landscape management practices that have been lost in decades past. Additionally, interviews from a community affected by wildfires allows for optimism

that a refreshed, or even newfound, sense of community and togetherness can not only arise in the aftermath of a wildfire, but provide a foundation upon which effective preventative measures can be built. It is the comprehensive understanding of social and ecological changes characteristic of a sustainability science-based approach to the problem of increasing wildfire activity which ultimately allows for the emergence of these holistic and integrated solutions.

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7 Appendix

7.1 Example: Semi-structured interview prompts

7.1.1 Italian

Età:
Sesso:
Occupazione:
Paese/Regione:

- Quali sono i mezzi di sostentamento principali della zona/paese? L'agriturismo, coltivazione agricola (olive, vigneti, etc.), o cosa altra?
- Dipendi dal bosco per il tuo mezzo di sostentamento? Se è così, come l'usi?
- Secondo te, quali sono altri benefici del bosco? Riguardante l'ambiente o per la spiritualità, forse?
- Ci sono piante nella foresta (come un tipo di albero, i castagni) o raccolti (olive o vite) che consideri importanti per te per ragioni non economiche? Se è così, perché è importante per te?
- Secondo te, c'è un connessione fra il cambiamento climatico e gli incendi?
    - Hai visto un cambiamento nell'aria, nel suolo, o qualcos'altro negli anni scorsi?
- Hai visto una distruzione nell'area del bosco prima degli o a parte degli incendi (come l'abbandono dei boschi, o la conversione alla proprietà commerciale?
- Come il fuoco ti ha colpito? Come il fuoco ha colpito il paese? Tutti sono stati colpiti nello stesso modo?
- Ci sono stati qualsiasi cambiamento nelle pratiche agricole o nella gestione forestale dopo gli incendi?
- Affrontare il fuoco ha cambiato qualsiasi cosa nel rapporto fra te e i tuoi vicini o la tua comunità? Come vi avete aiutavi? C'era un senso di solidarità?
- Prima e dopo il fuoco, cosa è stato fatto per prevenire o combattere gli incendi? Chi era responsabile di questi mezzi? AIB o qualsiasi organizzazione a parte di AIB?
- Quali tipi di metodi riabilitazione sono stato fatto nelle zone colpite del fuoco? C'erano sforzi di riabilitazione nel bosco?
- Avete visto un cambiamento nella proprietà della terra dopo il fuoco? La terra è la proprietà dello stato, delle aziende, o dei proprietari terrieri privati?

7.1.2 English

Age:
Gender:
Occupation/Role in the community:
Town/area/region:

- What are the main livelihoods of the area/country? Agrotourism, agricultural cultivation (olives, vineyards, etc.), or something else?
- Do you depend on the forest for your livelihood? If so, how do you use it?
- In your opinion, what are the other benefits of the forest? Perhaps concerning the environment or for spirituality?

- Are there any plants in the forest (such as a type of tree, chestnuts) or crops (olives or vines) that you consider important to you for non-economic reasons? If so, why is it important to you?
- In your opinion, is there a connection between climate change and fires?
    - Have you seen a change in the air, soil, or anything else in the past few years?
- Did you see destruction in the woodland area before or in part of the fires (such as abandonment of woodlands, or conversion to commercial ownership?
- How did the fire affect you? How did the fire affect the village? Was everyone affected in the same way?
- Have there been any changes in agricultural practices or forest management since the fires?
- Has dealing with the fire changed anything in the relationship between you and your neighbors or community? How did you help each other? Was there a sense of solidarity?
- Before and after the fire, what was done to prevent or fight fires? Who was responsible for these efforts? AIB or any organization that is part of AIB?
- What kinds of rehabilitation methods are being done in the fire affected areas? Were there rehabilitation efforts in the forest?
- Have you seen a change in land ownership after the fire? Is land owned by the state, corporations, or private landowners?