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Local Perceptions of Fires Risk and Policy Implications in the Hills of Valparaíso, Chile

Rodolfo Sapiains [1,2,*], **Ana María Ugarte** [1,2], **Paulina Aldunce** [1,3], **Germant Marchant** [1,2], **Javier Alberto Romero** [4,5], **Mauro E. González** [1,6] **and Valentina Inostroza-Lazo** [2,4]

1   Center for Climate and Resilience Research (CR)2, Santiago 8370449, Chile; amuc@u.uchile.cl (A.M.U.);
    paldunce@uchile.cl (P.A.); german.marchant@ug.uchile.cl (G.M.); maurogonzalez@uach.cl (M.E.G.)
2   Department of Psychology, Faculty of Social Sciences Universidad de Chile, Santiago 7800284, Chile;
    valentina.inostroza@ug.uchile.cl
3   Department of Environmental Sciences and Renewable Natural Resources, Faculty of Agronomic Sciences,
    Universidad de Chile, Santiago 8820808, Chile
4   REDLAMA (Latinoamerican Educational Network for the Environment), Center for Climate and Resilience
    Research (CR)2, Santiago 8370449, Chile; javier.romero.h@ug.uchile.cl
5   Department of Sociology, Faculty of Social Sciences, Universidad de Chile, Santiago 7800284, Chile
6   Faculty of Forestry Sciences and Natural Resources, Conservation, Biodiversity and Territory Institute,
    Universidad Austral de Chile, Valdivia 5090000, Chile
*   Correspondence: rodolfo.sapiains@gmail.com

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Abstract: Climate change is increasing the occurrence of natural disasters worldwide, and more frequent and intense fires represent one of the most destructive expressions of this trend. Chile is highly vulnerable to climate change, and fires are a recurrent phenomenon affecting many people each year. To reduce fire risk, the Intergovernmental Panel on Climate Change (IPCC) suggests reducing both exposure and vulnerability through multiple initiatives, which demand increased community engagement. In such a context, this study explores local perceptions of fire in a sample of inhabitants in a wildland-urban interface (WUI) in Valparaiso, a city that is affected by numerous fires each year. The ultimate goal was to identify psychological and community factors that should be taken into consideration to develop prevention plans and safer environments for people living in a context of poverty and social inequity. Using a qualitative approach, 28 interviews were conducted and analyzed following grounded theory principles. Results identified multiple causes, impacts, and characteristics of the problem perceived by people who permanently cohabit with fire risk, showing that for many of them, fire risk is not about the probability of occurrence of a disaster, but a question about when and how the next fire will happen. However, in such a complex scenario, psychological, community, and structural barriers deter people from implementing more effective actions. Conversely, in emergency situations, such barriers are irrelevant and cooperative actions prevail, suggesting the existence of resources and capacities within the community that could lessen exposure and vulnerability if activated on a day-to-day basis. Overall, reducing fire risk cannot be achieved by local communities alone nor without their support. To build, maintain, and consolidate fire prevention actions, it is critical to activate community strengths and cooperation and engage the resources and management capacity of local governments.

Keywords: fire risk perceptions; fires prevention; disasters risk reduction; Chile; climate change

1. Introduction

Climate change and variability are increasing the magnitude and frequency of socio-natural disasters [1]. Among these, fires are one of the most destructive phenomena with unprecedented

suppression costs, property loss, natural resource damage, and loss of life often involved [2,3]. In Chile, the total area affected by fires has increased by 70% in the last decades, and the fire season has been extended [4,5].

Disaster risk is the likelihood of suffering disasters, such as fire, that result in multiple impacts on society. According to the Intergovernmental Panel on Climate Change (IPCC), the risk is defined by three factors: hazard, exposure, and vulnerability [6]. Hazard is the potential occurrence of a natural or human-induced physical climate-related event, which can be influenced by both natural climate variability and anthropogenic climate change. Exposure is the presence of people, livelihoods, environmental resources, and infrastructure in places that could be adversely affected. Finally, vulnerability is the propensity or predisposition to be affected by such phenomena [6].

In Chile, the region of Valparaíso is one of the three most affected by fires (15.7% of the total events occur in this region) [4]. Large fires (>200 ha) have risen by 27% above the historical average [4]. In Valparaiso city, many fires are concentrated in wildland-urban interfaces (WUI). According to Stein et al. (2013) [7], WUI are zones where people coexist with land used for activities such as forestry and agriculture. In Valparaiso in particular, there are wide areas of unmanaged vegetation that are also used as illegal dumps increasing fire risk. The local municipality estimates that more than 100 fires occur in Valparaiso city each year [8].

According to the IPCC (2014) [9], to reduce the impact of disasters through disaster risk management and adaptation, the focus must be on reducing exposure and vulnerability, which are influenced by a wide range of factors. Other perspectives [10] suggest reducing vulnerability involves limiting exposure, developing the capacity to anticipate, cope with, resist, and recover from the impact of natural hazards. In any case, vulnerability is deemed to be one of the most important factors to understand the unequal distribution of risk and, therefore, it is one of the key factors to be addressed in disaster risk reduction. Adaptation, on the other hand, is defined as the process of adjustment to actual or expected climate and its effects. When the impacts, uncertainty, and complexity reach a high magnitude, incremental adaptation also reaches a limit, and then transformation is the only option making even deeper changes necessary [11–13]. In this paper, we focus on risk perception as one of the factors that influence and shape how people prepare and respond to fires in a changing climate.

Multiple studies have addressed fire perceptions and their interaction with disaster risk reduction behaviors [14–18]. For example, one study shows that people who have suffered a wildfire experience do not necessarily have greater risk perception for these events [19]. In another study with a population from the Colorado WUI, it was found that older people implemented more disaster risk reduction measures and were more likely to take structural actions [18]. Other studies [16,20] have addressed the underlying factors of disaster risk reduction behaviors showing that social interaction shapes the way in which communities perceive and respond to wildfire risk. The perception of this risk is positively associated with the following: (a) participation in community groups, (b) wildfire-specific informal interactions such as sharing specific fire information with neighbors, and (c) wildfire-specific formal interactions such as receiving information from experts.

A literature review on wildfire risks and perceptions [21] found mainly studies from the United States, Canada, and Australia. Results show the importance of community and institutional interaction and trust between stakeholders, and the relevance of policies such as urban planning for fire risk management. Similarly, another review by McCaffrey (2015) [22] highlights the importance of local networks and relationships, local and expert knowledge, and institutional capacity. The author also found that wildfire risk perception does not necessarily relate to wildfire responses. One final revealing point is that there is a highly coherent discourse across the countries covered in the studies reviewed.

Recently, a study conducted in Sweden found similar results showing that risk awareness was not enough to explain the general public's acceptance of risk management strategies, being also important the consideration of ecological values and beliefs, in this case, related to the forest [23]. In the same country, and following the largest fire recorded in Sweden in modern times (2014), a study showed that

people perceive an increased risk of this type of disaster because of climate change but that the 2014 experience can be a learning opportunity to improve prevention and preparation for future events [24].

In Chile, Acevedo and Cárdenas-Jirón (2018) [25] addressed the rebuilding process of housing after a large fire in Valparaiso in 2014. The study shows that some inhabitants tend to rebuild their homes in the same place they inhabited before the fire, even though their houses were located in high-risk areas where it is also difficult for fire trucks to access. The weak or lack of urban planning in the city increases other existing risks. Similar results were found by Bailey and Zenteno (2015) [26], suggesting that the high level of social vulnerability to a great extent explains the resistance of people to move away from the places where they lived after a fire destroyed their homes (they do not have the resources to buy new land, while at the same time the place they lived was free or affordable). Fire risk also persists because of the precarious conditions of the old and new houses to which they have access, often without basic services, in socially hostile environments (delinquency, drug-related issues), and/or in fire-prone ecosystems.

To our knowledge, the study of local perceptions of fire in Chile in general, and in Valparaíso in particular, is scarce. In such a context, this study aimed at exploring the local perceptions of fire of people from two communities located in a WUI in the Cerro Los Placeres, Valparaíso. We strongly believe that exploring these issues is paramount to improving prevention plans and policies at both the local and national levels. At the same time, this can help to understand the key role of psychological and community factors in the development of safer environments for people living in a context of poverty and social inequity, in line with UN Sustainable Development Goals, especially numbers 3 (good health and well-being) and 11 (sustainable cities and communities [27]), thus, contributing to the emerging field of psychology of sustainability.

Finally, it is important to clarify that although local communities do have a critical role in reducing fire risk and in mitigating their impacts, a community-based or bottom-up approach will hardly solve the problem alone. In fact, in this article we use a non-idealized definition of communities assuming that although they might share a common history, have close and frequent social interactions and a sense of belonging, among other characteristics pointed in classic psychology of communities' definitions [28,29] and even share a territory, they are generally heterogeneous, with internal power struggles and sometimes blurred borders that can make difficult the implementation of Disaster Risk Reduction (DRR) plans.

2. Materials and Methods

This study used qualitative methods to approach the research question [30], following grounded theory principles [31]. Participants were inhabitants of two communities, Las Palmas 1 and Huilmo, located on Cerro Los Placeres, Valparaíso (Figure 1). This sampling decision was made with the municipality of Valparaíso that was working on a fire risk management plan. Participants were selected based on the criteria that they lived in socially vulnerable communities located in a WUI with high fire risk, but they had not suffered a massive fire in their area. Both conditions were important considering the growing interest of the municipality in fire risk reduction and preparation.

Participants (n = 28) were chosen through theoretical sampling [31] considering sex, age, time living in the city, and time living in the locality. A snowballing technique was used to recruit participants. Table 1 shows the sociodemographic characteristics of the sample. All participants were informed about the goals, methods, and expected impacts of the study. Then, if they agree, they were asked to sign an informed consent making them clear they could end their participation at any time during the interview and that their responses will remain anonymous. Semi-structured interviews were used to collect data [32]. A running sheet covering the following issues was designed (Supplementary Data Materials): beliefs about fires, perception of the causes, the psychological implications of living in this risky area, social and environmental vulnerabilities, actions to prevent and deal with fires, and social interactions within the community, with the local authorities, and with other stakeholders. Interviews were conducted in people's houses between September and December 2018, lasting 60 min

on average. Individual interviews for data collection ended when information became redundant reaching theoretical saturation.
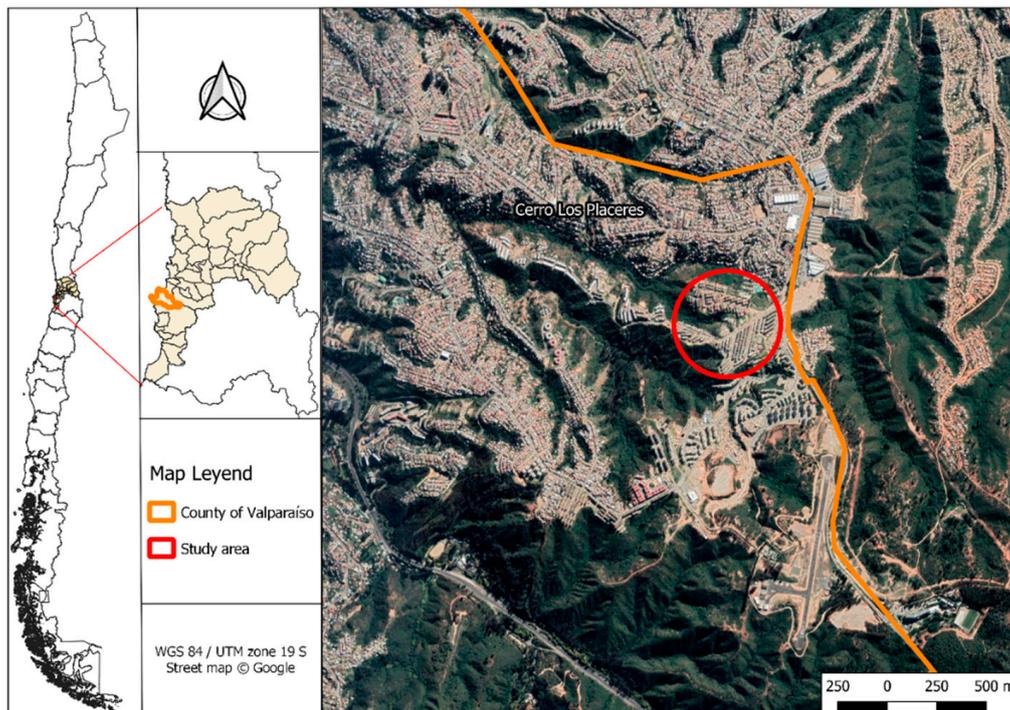

Figure 1. Study area. Cerro Los Placeres, Valparaíso City.

Table 1. Characteristics of participants.

ID	Locality	Sex	Age	Time Living in Valparaíso	Time Living in the Locality
E1	Las Palmas	Female	75	75 years	25 years
E2	Las Palmas	Male	53	53 years	25 years
E3	Las Palmas	Male	19	19 years	19 years
E4	Las Palmas	Female	37	15 years	15 years
E5	Las Palmas	Male	57	58 years	25 years
E6	Las Palmas	Male	26	26 years	24 years
E7	Las Palmas	Male	68	24 years	24 years
E8	Las Palmas	Female	35	35 years	24 years
E9	Las Palmas	Male	37	24 years	24 years
E10	Las Palmas	Female	40	40 years	2 years
E11	Las Palmas	Male	68	58 years	4 months
E12	Las Palmas	Female	89	89 years	25 years
E13	Las Palmas	Male	19	19 years	6 years
E14	Las Palmas	Female	60	30 years	24 years
E15	Huilmo	Female	74	66 years	18 years
E16	Huilmo	Female	67	24 years	20 years
E17	Las Palmas	Female	59	24 years	5 years
E18	Las Palmas	Male	27	27 years	27 years
E19	Las Palmas	Male	47	47 years	5 years
E20	Las Palmas	Female	54	24 years	24 years
E21	Huilmo	Female	73	73 years	20 years
E22	Huilmo	Female	55	55 years	20 years
E23	Huilmo	Female	63	63 years	24 years
E24	Las Palmas	Male	67	24 years	24 years
E25	Las Palmas	Female	54	54 years	25 years
E26	Las Palmas	Female	62	62 years	8 years
E27	Huilmo	Female	61	61 years	19 years
E28	Las Palmas	Female	69	69 years	24 years

Grounded theory was used to analyze the data. This approach allows, unlike other qualitative analyses, to build a theoretical hypothesis from the discourses of people directly affected by WUI fires. In other words, it contributes to the generation of theory in social psychology and other disciplines, from the experiences of the communities. Grounded theory aims at generating in-depth descriptive and relational analyses, identifying and classifying the information first in a conceptual way, and then defining thematic axes and relating them to each other, according to their properties and dimensions, to finally propose a hypothesis [33]. Procedurally, after transcribing the interviews, the data were classified into codes and organized into categories by all the authors who participated in the analysis. These categories were then thoroughly examined by the authors, to ensure their thoroughness and relevance. Subsequently, the relationships between these categories were discussed and the main axes of the discourse were identified. Finally, based on these relationships, the theoretical hypothesis presented in the discussion of the results was deduced. Software ATLAS.ti 8.4.24.0 was used throughout the process.

3. Results

Based on the analysis of the information, we organized the results in four main discursive categories (living at risk; highly vulnerable communities; fire triggers and prevention tactics; and social and psychological barriers and drivers for fire prevention), which we describe below. At the end of this section, we present the axial analysis and the possible interactions between these categories.

3.1. Living at Risk

Participants describe fires in Valparaíso as large-scale disasters that can affect many hills and communities in a very short period of time: "The La Cruz Hill about five years ago disappeared almost entirely in a fire . . . and from there it embraced everything in its path... making roads towards other hills and from there another hill burned, and from that hill, it jumped to another hill, and so it went" (E3). Fires are perceived as particularly destructive, frequent, and frightening events that generate chaotic, dramatic, and uncontrollable situations.

Some people state that not even large earthquakes (common in this region) are as devastating as fires: "First, all nature is destroyed. And if we talk about material goods, with house fires, everything is destroyed . . . . Fire is worse than an earthquake. I prefer an earthquake a thousand times over a fire because in an earthquake a part of the building falls and you will find—although destroyed—you will find part of it (...) A fire destroys everything, animals, insects, people, everything, everything, all the material goods, and the people have spent years to build (their homes) . . . " (E8).

For these communities, fires are part of the history of Valparaíso. They know that every summer there is a high chance of destructive fires somewhere in the city or its surroundings. As inhabitants of Valparaiso, most participants in this study have been affected directly or indirectly by a fire: "I: How many fires have you witnessed with your family here? E4: Like 5 or 6 fires, out there, the ones that I really remember, but the biggest ones were the ones that burned the hills. Ahh . . . no, there have been more fires, maybe 10. Yes, because here in Las Palmas . . . I've had to leave because I'm asthmatic. My son is also chronic, so I've had to leave all the stuff and just go. So then, it's very complicated when there are fires here (in the city)" (E4).

The permanent risk is mainly associated with the climatic conditions and stretches of unmanaged fields or forests that, especially but not exclusively, in summer create an increased risk of fire. High temperatures, low humidity, and strong winds are deemed to be the main triggers, whereas the geographic characteristics of these hills, mainly wide areas of seasonal dry vegetation, generate ideal conditions for the ignition, and especially for the propagation of fires: "I think that goes for the weather. I believe that the theme of the wind, for example, when the three conditions are there (heat, dryness and strong winds), fires occur alone, but the wind is the factor here, the strong one that gives them the strength to spread the fires... to spread completely. Apart from that, it grabs you to one side and then

the wind changes to another side and catches you to another side. And so it goes forward for different populations" (E3).

Furthermore, climate change is perceived as a factor that is altering the start and the length of the fire season, creating uncertainties and increasing the risk of disaster in different periods of the year: "The weather is so changed (...) I remember that in March when the children started school, the heat was intolerable from February until March, half the day, until four in the afternoon. Maybe it drizzled because there are days that it drizzles and then in the afternoon it clears, all the month of February. Now, (...) imagine in August, September, the winds begin and the heat (...). Before the strong winds started just in September or October (...) with the change in the seasons of the year. (...) I think it's about ten years or so that the weather has started to change" (E14).

However, the direct effect of human intervention on the environment is clearly identified as a fundamental part of this growing risk with the accumulation of combustible material especially on the streets and hillsides, consisting of broken glass, old mattresses, plastic waste, aerosol cans, and rubbish in general: "In the gully, they throw a lot of junk, a lot of... mattresses, um, What don't they throw? The rubbish was not taken away and into the gully it went" (E16). Along with this, people mention the presence of stray dogs spreading rubbish, and the poor, casual or inexistent care for green areas, the cumulative effect of deforestation, abandoned exotic plantations, and the occupation of certain areas by poorer people living on land seizures, all of which contribute to the problem: "There are a lot of people living on land seizures, and they are all using the electricity posts (...) If you can imagine, they don't have any meter boxes. If something happens there, the light goes out because the current jumps. They have no circuit breaker; they are connected directly (to the post). When there is a short circuit there, stuff just burns" (E4).

Most of the above reflect the weak, conflicting and insufficient urban planning in the whole city that has favored unregulated growth: "Here the environment has changed because when we first arrived this was just wasteland; we were the last apartments here (...) and now everything is populated on all sides" (E14). This type of growth has had multiple negative impacts on the environment: "Here below was the Nature Sanctuary, the Quebrada Cabritería Norte. Now it is converted into a Sanctuary of garbage, and that thanks to the authorities that are not worried about taking care of this sector. This is a lung that it serves the community" (E15).

3.2. Highly Vulnerable Communities

Overall, participants identified multiple social issues in their communities, generally associated with poverty conditions. These include drug-related problems (traffic and consumption), delinquency, a high level of hostility among neighbors, poor conditions of overcrowded social residential buildings, poor jobs, lack of recreational areas, and the existence of people in nearby land seizures living in even poorer conditions. These factors impact people's perceptions of what can be done to improve preparation for fires and community organization overall.

Similarly, structural issues are mentioned, the most important being the inefficient, inadequate, and unstable waste management system. There is wide criticism of how the municipality deals with this problem. Garbage collection only occurs one or two days a week in these communities. This is clearly not enough considering not only the amount of rubbish accumulated and the absence of recycling bins, but also that the size of the apartments makes it difficult to keep the rubbish inside the buildings: "What happens here is that people throw a lot of bulky things on the street, such as mattresses, ovens, washing machines, and all that accumulates. A garbage truck passes once a week, a municipal one that takes all those big things, but it seems that they throw out even more. It is never-ending" (E25).

This has multiple implications including the permanent presence of rubbish on the streets, the deposit of waste on hillsides, and the existence of illegal dumps in different sectors. In such a context, people refer to the irresponsible behavior of their neighbors or people from other communities, who bring rubbish to these sectors, as a critical component of this problem and as one of the main issues behind fires: "But the same people have no culture of being cautious, of cutting the dry grassland,

of not throwing garbage.... Now the president of the neighborhood council has to ask for a truck to dispose of the rubbish of people who no longer use their mattresses, who no longer use their stoves or living room furniture.... It takes forever.... I believe that once a year they lend that truck, and it gets full and then they wait another year? Then it's easier to dump it all in the gully … " (E22). In this regard, people perceive that authorities do not care about what happens in this sector. Because of their geographic location (on top of a hill near the edge of the community) or access difficulties, or the structural lack of urban planning, people feel they are highly vulnerable to fires and do not see this as changing in the short or mid-term. On top of this, there are serious concerns about the state of fire hydrants, the number of firefighters, and the public budget to reduce fire risk.

3.3. Fire Triggers and Prevention Tactics

Participants perceive fires as multi-causal disasters. Also, in many cases, the distinction between ignition and propagation factors is unclear or deemed to be irrelevant. For the purpose of clarity, the causes mentioned were organized in three main groups: caused intentionally, unintentionally, or through negligence (Table 2). Intentional ones are attributed mainly to acts of vandalism, pyromania, and the actions of individuals, institutions or private companies that benefit from the occurrence of fires: "Yes, the majority are intentional, to take the land or to build more houses (...), or buildings. For me, perhaps … how many companies are involved?" (E28).

Table 2. Percentage of the sample (n = 28) that mentioned each of the following fire triggers.

Type of Cause	Category	Percentage
Unintentional	Supernatural	4%
	Accidents	21%
	Heatwaves and dryness	21%
	Wind	46%
Intentional	Individuals or industries with a vested interest	21%
	Vandalism	36%
	Pyromaniacs	36%
Negligence	Irresponsible practices in land seizures	18%
	Inadequate electric installations	21%
	Poor vegetation management	29%
	Disposal of lit cigarettes in risk areas	43%
	Actions committed under the effect of alcohol and other drugs	43%
	Irresponsible behavior when barbecuing or cooking, or in jobs related to the informal economy	61%
	Inefficient rubbish management system	86%

Negligence is mainly associated with the rubbish problem. The perception is that the accumulation of different types of combustible material is the key issue explaining the occurrence and magnitude of fires in the city. In particular, the disposal of lit cigarettes in risk areas was considered one of the most important ignition factors. Other identified causes were actions committed under the effect of alcohol and other drugs by youngsters and adults, irresponsible behavior when barbecuing or cooking, lack of security in jobs related to the informal economy, the lack of maintenance of electric and gas appliances, and poor electric installations. In nearby land seizures, the prevalence of all these factors is multiplied, with a perception of increased risk for the whole hill.

Unintentional or accidental fires are mainly associated with natural factors that combined with some of the issues mentioned above ignite and propagate fires. Among these are climatic conditions such as heatwaves, strong winds, and low humidity. Additionally, different types of accidents were recalled by some including a small airplane crash. Finally, an evangelical participant mentioned supernatural causes with fires being another sign of the end of times.

The main fire prevention tactics mentioned included keeping the streets, residential buildings, hillsides, and, in general, all public spaces clean. Along with this, weeding and taking care of the vegetation on the hillsides and in private gardens are considered priorities as well as the maintenance of electric and gas installations and appliances by certified technicians: "The first thing you have to check is the type of installation [and that] the person you hire has a certificate that says I am this person, I have this profession, and as such, I can do this job" (E11). However, this is problematic because of the prevalence of non-certified workers that do this without the expertise or knowledge required.

Participants also pointed to education as a path to prevent fires. Through seminars, fairs, green groups, the creation of brochures, some people want to promote and reinforce the importance of keeping the community clean, avoiding littering, taking care of the surrounding nature, and other actions mentioned in this section. In doing this, responsibilities are shared with the municipality, firefighters, the police, and universities among other stakeholders.

Overall, these actions require high levels of individual commitment and adequate levels of organization to ensure their success and continuity. To these, we could add other activities such as monitoring suspicious activities of people who could initiate a fire, installing an alert system when a fire is starting, setting-up fire-breaks, cleaning and fencing areas where illegal micro-dumps are, demanding the maintenance of water hydrants by the responsible private water companies, and identifying safe zones, escape routes, and emergency evacuation plans. All of these require commitment, organization, and resources.

In most cases, the implementation of these actions is strongly related to the funding and human resources of the municipality and other local actors such as firefighters, CONAF (Forestry National Corporation), and private companies associated with water supply. In particular, people perceive the municipality as primarily responsible for the improvement of the inefficient waste management system and the certification of technicians. Certain actions require more than community participation alone. For example, in everything related to cleaning the streets, preventing illegal dumps, weeding the hillsides, setting up fire-breaks, and maintaining green areas, the participation and financing of the municipality are perceived as fundamental to an effective, sustainable and efficient outcome.

3.4. Social and Psychological Barriers to Fire Prevention

In spite of the fire risk, most participants stated that the majority of the preventive actions listed above are not implemented. Multiple barriers were identified, operating at a psychological, community, and structural level. The main ones are presented below.

- Individualism is clearly one of the most important barriers mentioned by the participants. Implementing any activity becomes a challenge for the local neighborhood committees that end up working with a small number of people, generally adult women. Many participants state their neighbors only care about themselves, their families, and their personal security. Furthermore, in many cases, the community is not organized enough to assist in prevention and safety, leaving individuals to look after themselves: "Look, the last fire in 2016 I think, in the summer ... was in Rodelillo. We didn't evacuate because of the fire, but because of the smoke issue, because there was too much smoke. We had to go for a walk around the center, do other things, but it was more of a family decision to take the initiative than a community one" (E6).
- Assitentialism culture. (Assistentialism is a concept widely used in Latin America to describe government policies aimed at people's financial or social assistance, but which in reality seek to solve only the symptoms of the social problem, not its root causes. According to Freire (1973; in Bhattacharya 2011), this approach is very problematic for societies, since it inhibits citizen participation in governance processes, does not promote dialogue, and imposes silence and passivity, denying conditions for the development of social and political awareness in the population (Asoke Bhattacharya. 2011: Paulo Freire: Rousseau of the Twentieth Century. The Netherlands: Senses Publishers)).Participants affirm that people in their communities are not willing to engage in more demanding actions because they prefer to wait for others to do it,

especially the local and national authorities: "The first thing they say (the authorities), no, you have to clean yourselves. I understand. We also have to make a contribution. Unfortunately, most people do not like to clean here; they like everything done for them." (E15).

- Weak community interactions. Although nowadays that may characterize many cities and communities, the high risk of fire does not seem to motivate people to get actively involved in fire prevention: "I believe that nobody is prepared . . . because very few of the neighbors, almost all, are inside their homes. There are very few with whom one interacts. We even have a meeting, 4 or 5 neighbors go (. . .) They don't go anymore because nobody is interested. People are like . . . this is my house, inside, and they are not interested in what happens outside at all" (E21).

- Low participation. Along with the above, there are multiple difficulties for community organization and participation. This can be observed in the low participation in activities that do not report immediate benefits or recreational opportunities "Yes, there must be workshops, but people do not attend. People are worried about their homes, staying inside, watching TV, preparing dinner. Here, the neighborhood committee people are the only ones who participate, who mobilize the others" (E15).

- Lack of time. This is generally explained by highly time-consuming jobs, and long school hours, all of which is expressed in the presence of very few people in the neighborhood during weekdays. This is particularly important for men, whose participation in community activities other than recreational ones, is low: "People work, work all day, Monday through Friday or Saturday. And nobody is around during the weekdays" (E11).

- Fear and lack of trust. High levels of aggression in some neighbors deter many people from participating in community activities or even in using public spaces or promoting behavioral changes: "because people don't understand; they are dirty. A lady at the back of the block, she was caught pulling an armchair down to the gully and some neighbors tried to stop her, and she became very aggressive.... It was so bad. There should be maybe a camera that would record things like this . . . .A big fine or something. I think they could learn a lesson and wouldn't do it anymore" (E21).

- Delinquency and drug-related issues. These problems are identified as a central component of the community and are associated with violent attitudes and behaviors, increasing the fear in those who are not involved in these illegal activities: "Here there are older people who are afraid... very afraid. There are people who verbally insult you . . . You know how youth is now, super-aggressive... but I find that the community does not care much about this. Because if we were many, we would have thrown them out . . . but we have no help, as I say... the police come and tell them—this and that one complained about you—and I have heard it"(E22).

- Low perception of control. The magnitude and characteristics of fires in this city contribute to creating the perception of these events as disasters that are difficult to avoid. Once a fire starts, the perception is that there is nothing people can do to stop it: "It takes everything in its path. It spreads, and you cannot stop it. Impossible to stop a fire! It might seem like there is no wind but when a fire appears, there's the wind and it sweeps everything with it. The flames are just waiting to say: "this is mine" and bye, no one can stop a fire. It cannot be extinguished" (E11).

- Lack of information. Many people state that education about fires is weak or non-existent. In some cases, inaction is associated with not knowing what to do or what are the most effective actions to be implemented: "Of course, we are not prepared for a fire. As I said earlier, here education is lacking . . . . When we were young, there was a fire brigade in the port, just in case. Now, we should have the same. People are not prepared. All we are going to do is look and call the police and they will call the Fire Department" (E5).

- Externalizing responsibilities. Many people state that dealing with fire risk is mainly the responsibility of the local and national authorities. For instance, the lack of financial resources for the firefighters and the lack of adequate infrastructure to deal with fires are deemed to be some of the main factors explaining the difficulties to address the problem.

- Inadequate rubbish culture. Participants point at bad habits (e.g., littering), poor education, or a local culture that does not encourage personal responsibility with the rubbish: "It's the education and the culture ... I live with a boy that people pay to throw away the rubbish, but this irresponsible kid goes and throws it into the gully because he doesn't want to take it to the corner" (E2).
- Self-serving bias. Participants pointed at others as responsible for many of the problems identified in these interviews. This is particularly clear regarding the rubbish issue. Either neighbors or people from other sectors are deemed to be the ones whose behavior is causing the problem. On the contrary, participants described themselves as doing their best to keep at least their places clean: "Regarding the issue of fires, I always clean. I cut the grass in the yard, the whole thing. But no, recently I have not done it. I did it last time in the summer, but I think that this time no more [because] I'm the only one who cleans" (E4).

Conversely, some drivers of preventive actions can be identified operating at different levels. These drivers described below include risk awareness, local knowledge, and social learning, motivated leadership, and solidarity in emergencies.

- Risk awareness. In spite of the barriers described and the difficult social conditions, there are people who are highly aware of the fire risk in this area, who are engaged in multiple activities related to cleaning the neighborhood, and who are making efforts to prevent fires: "My neighbor, who lives on the first floor, has everything super clean. She waters the front yard every night, downhill, to avoid any spark or anything that might start a fire" (E28).
- Local knowledge and social learning. As inhabitants of Valparaíso, most participants have had a direct or indirect fire experience. From this, they have developed different types of knowledge about how fires are ignited and propagated in the city that can be used in designing and implementing more effective responses: "There have always been fires in Valparaiso in summer, especially in Placilla, and the hills surrounding Placilla. They all burn because people cut the trees, and they leave them on the ground, so in summer all of that catches fire creating a disaster" (E22).
- Motivated leadership. Although community participation is generally low, participants recognize the new neighborhood committee leadership as far more committed to improving life conditions in the community than the previous one. This has motivated people to engage in more activities: "Yes, it's like the neighborhood committee is more awake now with the new President we have .... In the seven years I have lived here, I never saw the committee open, it was totally closed. Before if you needed some paperwork, you could never find the president, but now it's different" (E30).
- Solidarity in emergencies. Despite the multiple barriers identified, when an emergency occurs, all these issues are not an obstacle for spontaneous cooperation, solidarity, and the activation of intra- and inter-community networks. People describe many situations in which members of the community have positively reacted helping the elderly, or anybody who is at risk: "It's as though people come together when there is a disaster; they are very humanitarian. A spontaneous network forms to help" (E21).

3.5. Proposed Model

Interactions between the categories and subcategories described above are suggested in Figure 2. Overall, fire perception is influenced by the different components of fire risk. At the hazard level, people are aware of the historical recurrence of fire in the city and in the surrounding areas; at the exposure level, the population lives in a WUI area with climatic conditions that unfortunately favor the occurrence of fire (high winds, high temperatures, and low humidity), conditions that are being intensified by climate change; and in terms of vulnerability (increases because of climate change too), this is a population living in a poor socio-economic situation in a context of insufficient urban planning, inefficient waste management systems, and the perceived abandonment by the local authorities.
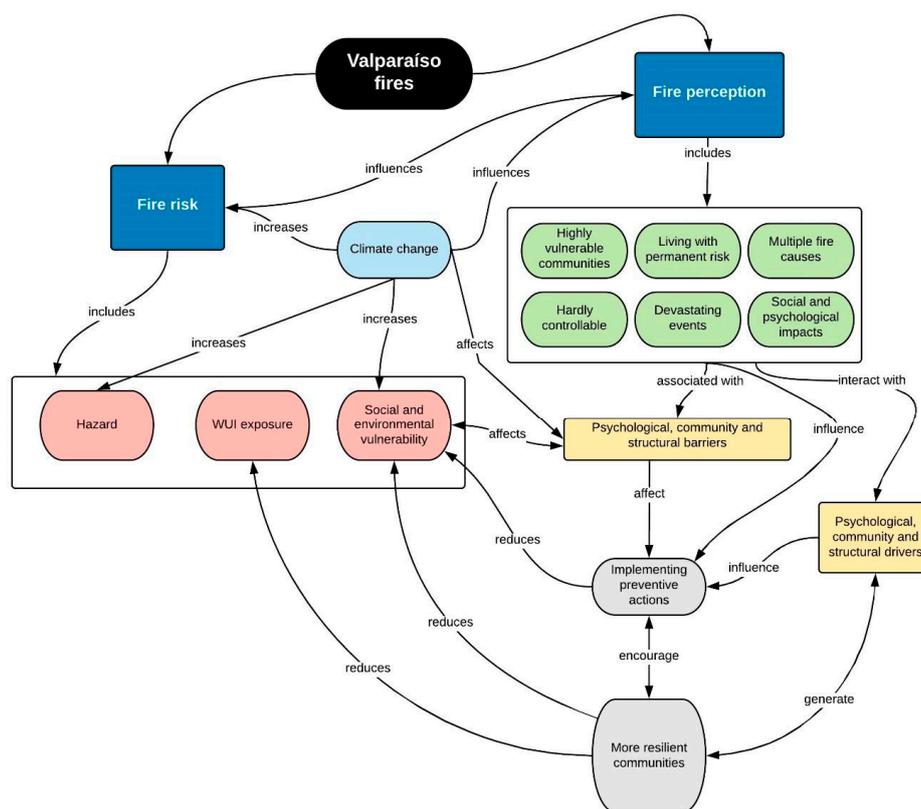
Figure 2. Relational Analysis.

Depending on the causes, impacts, and characteristics of fires identified by these participants, fire perceptions might lead to risk reduction actions. However, multiple psychological, community and structural barriers might deter this to happen, influencing the perception of fires as totally devastating events, hardly controllable and associated with high levels of uncertainty, damage, and chaos. Notwithstanding this, direct or near fire experiences recalled by these communities suggest the existence of different types of drivers that have been activated in emergency situations, improving the chances to adequately respond to such disasters, contributing or reflecting characteristics of a resilient community that might help to lessen both exposure and vulnerability to fires.

4. Discussion

The theoretical hypothesis that is proposed for this case study, based on the open and relational analysis, is as follows: risk is not perceived as the probability that a fire may occur, but rather as a certainty: the disaster is unavoidable, being only unclear how and when a fire will take place, although it would probably be associated with the accumulation of combustible material (rubbish and scrub) in the territory that people inhabit and will be more likely to occur in summer when temperatures are higher, the wind is stronger and the rainfall decreases. In this context, the multiple barriers (psychological, community, and structural) that hinder risk prevention and coping actions become more complex to address. It is, therefore, necessary to strengthen public risk management policies considering this particular context, which implies making structural changes at the institutional level, reformulating urban-territorial planning in these areas, expanding social participation in decision-making on these issues, and generating local action plans, involving all social actors. This is discussed in more detail below.

4.1. Fire Risk Perceptions: Barriers to Action

These results show that efforts to implement disaster risk management in Valparaiso have been insufficient, inadequate, or limited. People in this study perceive they are not prepared to prevent or to deal with fire risk. Similar to the findings of Champ and Berker-Smith (2016) [19], in these communities knowing there is a risk or even being witness to a fire is not necessarily associated with higher community engagement in prevention initiatives. In fact, we observed multiple psychological and communitarian barriers intervening along with structural ones (Figure 2), hindering preventive actions or making fire prevention not only a difficult endeavor but also a secondary issue for many people, even in these risky scenarios. At a psychological level, individualism, low perception of control, lack of information, externalizing responsibilities, and self-serving bias were observed which inhibit collaborative actions. At the communitarian level, assistentialism culture, poor community interactions, low participation, lack of time, fear, and lack of trust, delinquency, and drug-related issues affect people's motivation and perception of control on the problem. At the structural level, the main barriers observed were poverty, lack of trust in authorities, insufficient municipality resources, and weak urban planning. These barriers are similar to those identified by Gifford (2011) [34] related to climate adaptation, which is interesting considering the levels of poverty and the type of social issues that are probably very different from those found in Anglo-Saxon studies.

Another aspect to consider is that living permanently at risk generates stress. Sustained stress over time can cause damage to mental health, such as generalized or specific anxiety disorders, depression, or somatization [35]. In this case, the constant threat that a fire can happen at any time in the presence of the identified barriers to action constitutes an additional stress factor for the population, which might seriously damage their mental health. Scientific evidence indicates that socio-natural disasters can cause anxious and depressive symptoms, post-traumatic stress, sleep disturbances, alcohol abuse, problems in family interaction, and increasingly violent and suicidal behaviors [36–38]. It is also important to investigate these aspects, how they develop at the local level, and what specific implications they can have on the population.

In spite of all these adverse conditions, these results also show that in case of an emergency, all these barriers would not be an obstacle for certain actions. Cooperation, trust, and community networks are generally activated in such scenarios, which suggests that, at least, during and immediately after a disaster, the community has the conditions and the motivation to act. Among the drivers of such activation that might lead to the development of better responses, we can find at the psychological level, the local knowledge of the territory and the climate, a social learning process built (directly or indirectly) upon previous experiences with fires, and the risk awareness, that although it is not widespread, is expressed by many people. Similarly, at the community level, the existence of a group of highly motivated and organized people along with highly committed leadership, and the social norm of being supportive with people in need are all important factors. These results suggest that both levels of drivers are already in these communities. The challenge is to learn how to activate them on a day-to-day basis and not only during an emergency.

As other studies have shown [16,20], the quality of social interactions is critical for disaster risk management, and these cases are not an exception. In spite of all the difficulties reported above, the quality of the social interactions in these communities would still allow cooperative responses. Nonetheless, structural barriers along with climate change demand a wider approach. The growing importance of getting local communities engaged in disaster risk management [9] should encourage local authorities to increase support for community-based plans to deal with fires. However, as pointed in the introduction and illustrated in these results, such an approach must recognize the evolving, generally unstable and conflicting characteristics of communities and the importance of both, avoiding idealized views on this concept and being aware of the multiple internal conflicts expressed in the existence of divisions, lack of trust, individualism and so on that usually jeopardize DRR [10].

4.2. Policy Implications

Although natural and anthropogenic factors are mentioned to explain both the ignition and the spread of fires, the latter has much greater weight for the population, that is, fires are mainly the responsibility of human behavior, whether by intentionality, negligence, or accident. This is important considering the official data showing that 99% of fires in Valparaiso are caused by human actions [39]. However, addressing many of these anthropogenic causes represents a difficult challenge for the inhabitants of these hills. For instance, the historic rubbish management problem affecting Valparaiso might be mitigated by these communities, but it demands coordination with the local government and other stakeholders to develop more long-term, adequate and effective solutions. Poverty and drug-related issues are factors that strongly hinder the options for improving risk management and it is unlikely they will be solved in the near future. Moreover, factors such as pyromaniac behavior and vandalism, are generally unpredictable and, therefore, hardly controllable. This means that even in the best-case scenario, for instance, overcoming all the psychological and community barriers, fire prevention cannot rely on the action of local communities alone, and at the same time, it cannot be achieved without them. Similarly, people claim that only very few initiatives related to prevention have been carried out in their territory, and most of the actions related to fires are geared towards responding to them when they happen. Delivering fire-prevention education, promoting risk awareness, building local responses to address a disaster of these characteristics, and obtaining collaboration between different social actors to delineate action protocols are all complex tasks that must be implemented. Moreover, most preventative actions identified by these participants are relevant to reducing the risk in the territory they inhabit, i.e., within the WUI, but few of these actions aim at preventing fires in the wildlands where many catastrophic fires have been ignited and from there propagated to the nearby hills. This reinforces the importance of integrating multiple stakeholders in fire prevention. However, integrating the management of the adjacent wildlands and the WUI in overall urban planning is beyond the scope of these communities, and this lack of communication and cooperation could jeopardize any efforts the community makes.

Given such a complex scenario, communities, local governments, and any stakeholders who can be mobilized need to translate these problems into solutions by at least beginning to develop or transforming public policies. From our results, there are at least four important considerations (Figure 3). First, creating a local fire action plan not only implies considering the geographic characteristics of the localities where it will be implemented, but also the knowledge possessed by people living in such territories. In our case study, all the participants, directly or indirectly, had had the experience of facing a fire and had been part of an effort to mobilize resources and generate actions to deal with it. Moreover, Chile is a country of disasters; there is accumulated knowledge as popular knowledge on how to act in situations of this type. In fact, in many disasters, the first response has come from the affected communities themselves [11]. Rescuing this knowledge and integrating it with the technical and scientific knowledge that is relevant to the particular territory is one of the challenges in fire risk management.

Second, to develop preventive actions, community engagement is required and for this, it is necessary to promote social participation throughout the prevention process. One path might be to have a panel of experts previously define the actions needed and then communicate these to the communities through workshops or media campaigns; however, considering the lack of trust towards the authorities and all the difficulties already mentioned, it seems clear that such a top-down approach will have a limited impact on the population. In fact, several studies show that in issues related to the environment and disasters, a bottom-up perspective has been demanded, where community perceptions, proposals, and evaluations play a leading role [40–42]. Given the current situation in Chile, a horizontal, transparent, and binding participation should be the starting point of any community-based initiative, so that people can acquire a greater sense of control over the situation. Considering the multi-factorial character of the problem, the shared responsibilities, and the actions needed to be implemented at different levels, community participation requires high levels of coordination with firefighters, the local

government, and other key stakeholders. Although in this case such coordination has been found to be weak, it is deemed to be indispensable for many people and clearly for success in implementing many prevention responses [43].
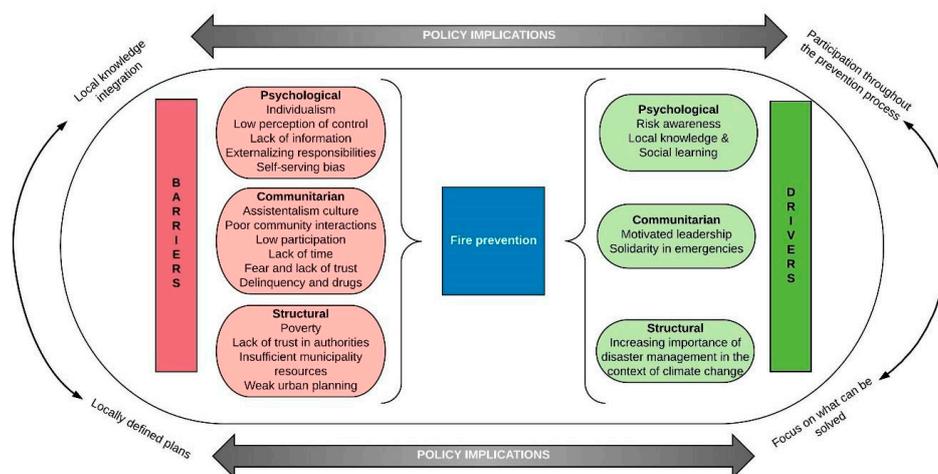

Figure 3. Policy implications.

Consistent with the above, it is necessary to create locally defined plans. This means that although there are general recommendations that might be useful in similar scenarios, a community-based approach should consider the specific cultural, social and psychological features of the local communities (including their internal conflicts, power struggles, and limitations), and the particular geographic and climatic conditions of the territory. Our results suggest that this has not been the case, and for whatever reasons (e.g., restricted public funds) this cannot be bypassed. For the local authorities, this also implies that in these particular cases, fire prevention is the responsibility not only of the disaster response unit or fire department, but rather it should engage all the institutions and offices working in the areas of poverty, environment, delinquency and other social issues.

Finally, fire prevention must focus on what can be solved. This is especially true in a context where deep social issues, such as those related to drugs, delinquency, and poverty, tend to significantly affect the perception of control people have not only in relation to specific problems such as fires but over their lives in general. In this process, identifying the resources (drivers) the local communities have and allocating responsibilities among different stakeholders might help to overcome the negative perception of themselves as a community and possibly increase a sense of empowerment, creating a positive loop between effective actions and improved social interactions.

5. Conclusions

Current climate scenarios predict conditions conducive to the occurrence of large-scale fires and consequently important socio-economic and environmental impacts affecting human well-being and the natural environment. Understanding the local perceptions of fire risk in the context of climate change is important to analyze, define, and improve the responses to deal with such a complex challenge. This study has shown the multiple causes, impacts, and characteristics perceived by people who cohabit with fire risk on a day-to-day basis in Valparaiso, one of the regions most affected by fires in Chile. These results illustrate that for many people living in highly vulnerable conditions, fire risk is not about the probability of occurrence of a disaster, rather it is just a question about when and how the next fire will happen. In such a complex scenario, integrating these local perceptions with scientific knowledge and institutional experiences is one of the main challenges to strengthen the resilience and adaptation capacities of local communities living in or around WUI zones and to advance psychological contributions to the specific answers to the UN's SDGs, especially those aiming at good health and well-being and the development of sustainable cities and communities. In fact,

to configure the landscape to be less exposed to fire and reduce fire vulnerability, policies should aim at both addressing the psychological, community, and structural barriers and improving or implementing WUI management to reduce the likelihood of new fires. Top-down approaches alone are insufficient to achieve these goals, especially considering the ongoing climate change scenario. To reduce fire risk, new policies must take into consideration an analysis of both the territory and its inhabitants to generate new, effective, and more cooperative interactions, strengthening the central role of community participation in designing and implementing preventive actions. In doing so, it is important to avoid idealized approaches to local communities assuming their heterogeneity and internal conflicts. Finally, limitations of the study are mainly related to the difficulties found in the recruitment process because the snowballing methods might influence the final composition of the sample. Future studies might dig deeper into the fire prevention drivers and barriers identified in this study in other hills of Valparaiso and testing transdisciplinary approaches to design new, cooperative, and long-term prevention plans.

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