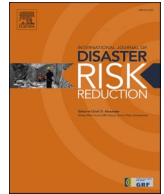




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# The triumph of post-disaster neoliberal planning after the 2021 volcanic eruption in Valle de Aridane (La Palma, Canary Islands)

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## ABSTRACT

The 2021 volcanic eruption on the island of La Palma (Canary Islands, Spain) demonstrated how existing spatial planning was unable to reduce vulnerability. It also opened up a window of opportunity to change volcanic risk perceptions since specific spatial planning legislation was needed to tackle the recovery and reconstruction of Valle de Aridane. However, more than three years after the start of the eruption, new spatial planning criteria finally adopted failed to take into account the hazards associated with a volcano. This is the main conclusion of a research based on the study of the documentation generated during the spatial planning process in the Valle de Aridane, semi-structured interviews with key actors in the process and the analysis of the local media. It also shows that the original idea of restricting settlement in the areas of greatest volcanic risk and reducing the dispersion of the population was abandoned after a change in the regional government. The dominant neo-liberal urbanism approach among new policy makers and their electioneering, coupled with the prevailing short-term vision of those locals who lost their properties, have led to serious failures in the governance of post-disaster volcanic risk. This perpetuates the vulnerability of future generations of local society to further eruptions. The case study therefore confirms how, once again, social, economic and political factors are highly relevant to understanding the magnitude of catastrophes associated with extreme natural events.

## 1. Introduction

Cumbre Vieja is a volcanic ridge that divides the southern half of the island of La Palma, in the Canaries (Fig. 1). All eight historical eruptions recorded on the island have taken place there [1], with the last three taking place in a period of only 75 years (Table 1). Although the 1949 eruption, known as the *San Juan volcano* eruption, was a clear warning of the potential devastating effects of extreme events of this kind [2], the magnitude of the catastrophe caused by the 2021 eruption clearly demonstrates the lack of a true volcanic risk culture within the local society.

Historical records provide sufficient evidence of the potential destruction that eruptions in the Canary Islands might cause [1]. However, these hazards have been played down politically, possible due to fears of the effects on tourism, the main driving force

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behind the archipelago’s economy in recent decades. It is worth remembering that in Spain, powers regarding natural risk prevention have been in the hands of the regional governments since the 1980s. In the specific case of the Canary Islands, some of these powers have even been transferred to the Island Councils (*Cabildos Insulares* in Spanish). This proximity between political decision-makers and society, which is usually considered one of the positive aspects of devolution, has increased risk downplaying in the specific case of the Canary Islands and La Palma. That may explain why the first Canary Islands Volcano Emergencies Plan (PEVOLCA, the acronym for the name in Spanish) was passed as late as 2010 and why the emergency caused by the volcanic eruption on El Hierro was poorly managed by local and regional authorities in a poorly manner according to some authors [3]. It may also explain why, in 2021, an island with such active volcanic areas such as La Palma did not have a Volcanic Risk Action Plan (PAIVPAL) and why one has still not been approved three years after the eruption even though it is legally mandatory.

The downplaying of volcanic risk explains why it has been ignored in spatial and urban planning on the islands, even though the hazard of such emergencies has been pointed out in different plans. As Table 2 shows, in 2003, the Civil Defence Emergency Plan for La Palma (PEINPAL) noted that volcanic eruptions, forest fires and torrential rain were the most hazardous potential events [4]. The La Palma Land Use Plan (PIOLP), the island’s main spatial planning document, took this same fact into account, stating that within two years of its approval, a Risk Prevention Plan [5] had to be drawn up, defining risk areas and determining the urban planning criteria and measures to be adopted in order to ensure the proper prevention and management of different hazards, including the possible exclusion of certain areas from urban development processes [6]. Although work began on the drafting of the document in 2015, it was never approved.

Lastly, apart from the above plans, in 2013, the Canary Island Government’s Directorate General for Safety and Emergencies commissioned a volcanic hazard map for La Palma [7,8], showing that the likelihood of a new eruption on the island was being

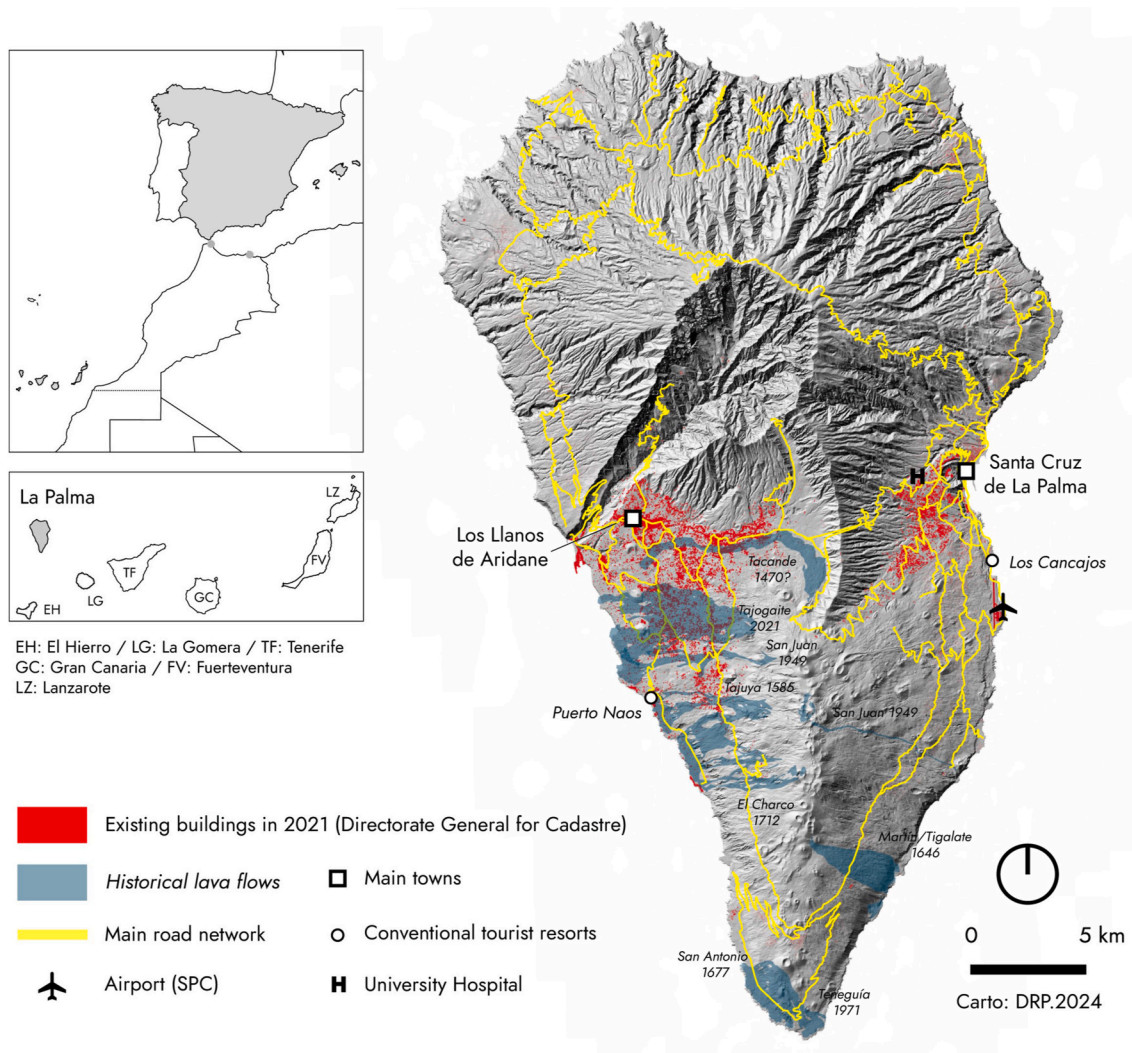


Fig. 1. La Palma: Spatial references. SOURCE: The authors, using QGIS.

**Table 1**  
Historical eruptions of the Cumbre Vieja volcano (La Palma).

Year	Eruption	From	To	Days	Rest time (years)	Area (Ha)	Main impacts
c. 1470	Tacande or Motaña Quemada	?	?	?	?	474	No information available
1585	Jedey or Tajuya	May 19, 1585	August 10, 1585	84	c. 115	454	Destruction of farmland and fire in the pine forest
1646	Martín or Tígalate	October 02, 1646	December 21, 1646	82	61	450	Destruction of houses and water tanks. Loss of livestock. Damage to beehives and to pastures. Fires in the pine forest of Fuencaliente
1677/8	San Antonio	November 17, 1677	January 21, 1678	66	31	242	4 deaths, with at least 1 from gas inhalation. Destruction of houses, water tanks and the 'Fuente Santa', a hot spring. Destruction of farmland and grazing land. Loss of goats
1712	El Charco	October 09, 1712	December 03, 1712	56	34	568	Destruction of houses and farmland
1949	San Juan: Nambroque, Duraznero and Llano del Banco	June 24, 1949	July 30, 1949	37	237	426	Destruction of hundreds of houses by earthquakes: 123 in Los Llanos de Aridane according to Ref. [2]. Destruction of farmland
1971	Teneguía	October 26, 1971	November 18, 1971	24	22	302	1 death due to gas inhalation
2021	Tajogaite	September 19, 2021	December 13, 2021	85	50	1.219	1 death probably due to gas inhalation. Destruction of 1562 dwellings, 370 ha of farmland (mainly banana plantations) 74 km of the road network and 1161 tourist beds

SOURCE 1: and information available at <https://web.archive.org/web/20150403051322/http://www.ign.es/ign/resources/actividades/volcanologia/TablaAmpliada.pdf>

seriously taken into account. From the map, the high probability of Valle de Aridane being particularly affected by lava flows from most of the simulated vents in the Cumbre Vieja area is sufficiently clear. Hence, although the volcanic risk was never taken into consideration as a constraint in urban planning decisions, it seems very likely that the public authorities had sufficient evidence to be aware of the potential hazards, especially at Valle de Aridane [9].

Bearing in mind the above background context, this paper analyses the spatial planning decisions that were made for the recovery and reconstruction of Valle de Aridane considering the window of opportunity that was opened up by the volcanic disaster to lay the foundations of a risk culture and minimise vulnerability. In other words, the aim is to check whether there was real volcanic risk governance during the post-disaster stage.

The following section offers a brief theoretical review of the role of spatial planning in post-catastrophe scenarios, highlighting how a strategy aimed at reducing risk can be hindered by the simultaneous coexistence of three factors: the absence of a risk culture, predominant neoliberal thinking, and an island setting. This is followed by an outline of the methodology and sources used in the research. Next, Valle de Aridane's recent spatial dynamics are presented, including indications of a high volcanic hazard in the area and on a large part of the island. An analysis is then made of the spatial planning proposal approved by the Canary Island Regional Government and the current scenario. Lastly, the paper finishes with an extensive discussion section and conclusions.

## 2. The spatial planning of areas at risk of extreme natural events

Spatial planning can aid in minimising the effects of catastrophes brought about by extreme natural events at two different stages [10]: prior to the event, through appropriate land use planning, by assessing potential risks and past experiences in order to reduce the magnitude of a catastrophe; and during the post-catastrophe recovery stage, by devising a prudent physical reconstruction strategy for the area that further reduces the risks if a future event were to occur.

This involves recognising that it is not the natural events themselves that cause catastrophes; instead, it is social, economic and political processes that determine the intensity of their impact, and so these processes are a key factor in identifying the vulnerability levels of societies and areas [11]. This conceptual approach is an implicit criticism of the tendency to describe catastrophes as purely natural phenomena [12], an attitude that predominated in the literature until well into the 1980s, despite the evident cultural and ideological implications of this association and the limits it imposes on understandings of catastrophes. The work of geographers like O'Keefe [13] played a pioneering role in questioning this notion in social science. As a result, new fields of research into catastrophes were opened up, focused on the idea of social vulnerability, the theoretical frameworks of which are clearly indebted to Marxist political economic thinking.

However, in the vast majority of cases, it is no simple task to put this kind of approach into practice, even in countries with high economic resources, like the USA [10], or in countries where there is legislation that considers mandatory risk prevention plans, such as France [14,15]. Leaving aside local or national peculiarities, there are two main factors that hinder the integration of risk reduction in spatial planning: the lack of a risk culture, and changes in objectives and priorities in urban and spatial planning brought about by dominant neoliberalism. Given the case in question here, it is also important to bear in mind the singularity of the limited surface area of islands affected by extreme natural events.

**Table 2**  
Mentions of volcanic hazards in some of La Palma's planning documents.

Plan	Year	Status	How hazard is dealt with	Mapping	Measures
La Palma Civil Defence Emergency Plan (PEINPAL)	2003	Approved	It notes forest fires, torrential rain and volcanic eruptions as the three most hazardous events. It indicates the existence of densely populated areas of the island that might be affected by the path of lava flows.	Maps based on publications by the geologist Juan Carlos Carracedo. The risk of Valle de Aridane being affected by lava is 'high' in the north and 'very high' in the south.	Advice for the population on how to act in the event of an eruption.
La Palma Land Use Plan (PIOLP)	2011	Approved	Forest fires, floods and eruptions are cited as high-risk events. It simulates the natural pathway that lava would take, based on 22 possible vents.	It presents a map of the possible direction of simulated lava flows, estimating over 10,000 buildings as possibly being affected, particularly in Valle de Aridane and also in Las Breñas.	It does not consider an eruption to be an imminent hazard, but it proposes that, within two years, a Risk Prevention Plan should be drawn up to determine the urban planning criteria and measures to be adopted for the appropriate prevention and management of different hazards, including the exclusion of certain areas from urban development.
La Palma Special Risk Prevention Plan (PTEPR-LP)	2016	Not approved	It identifies areas that are prone, to differing extents, to being affected by some of the phenomena associated with volcanic hazards (eruptions, lava flows, airborne pyroclastic material etc.) although the methodology is not clearly specified.	Detailed maps of susceptibility levels and specific human and economic risks.	An unfinished plan. The document outlining the measures to be adopted in order to reduce the impact of different hazards in high-risk areas was not drafted.
La Palma Volcanic Risk Action Plan (PAIVPAL)	2019	Not approved	This plan is not known because the document was not officially approved, and the version given to the Island Council in 2019 cannot be consulted.	An informative leaflet about the plan, distributed by the Island Council, contains a map of 'threat levels'. There are five different levels, with the north of the valley being rated 'low' and the south rated 'high'.	Not known.

SOURCE: PEINPAL: 4; PIOLP: 5; PTEPR\_LP: 6; PAIVPAL: <https://www.ull.es/portal/noticias/2019/plan-actuacion-insular-volcanica/> and [https://villademazo.com/wp-content/uploads/2021/10/Folleto\\_ciudadania\\_PAIV.pdf](https://villademazo.com/wp-content/uploads/2021/10/Folleto_ciudadania_PAIV.pdf)

### 2.1. The role of a risk culture

A risk culture can be defined as the 'knowledge, rules, values and measures taken at all levels of the social organization that determine, in a given space, a more or less elevated degree of preparedness in view of a disaster experience' [16]; hence, it is difficult to introduce changes through spatial planning aimed at reducing vulnerability when this culture does not exist. At the same time, discrepancies among the scientific community, the political authorities and potentially affected members of the population in weighing the hazards associated with an extreme natural event and the action to be taken in such cases [17] are a huge conditioning factor in the consolidation of a genuine risk culture.

Although the main hindrance in the creation of a risk culture has been considered to be the majority of the population's lack of awareness of the magnitude of natural hazards, this idea is increasingly being called into question, not just because we are starting to gain a better understanding of the complexity of the risk perception processes of lay people [18] but also because it is accepted that experts are prone to different biases [19,20]. As Douglas and Wildavsky noted in their seminal work [21], in the end, risk perceptions are largely dependent on people's sociocultural background context.

Consequently, the management of low-probability, high-impact risks is harder than the management of other more frequent risks, even though, in the first case, there can be devastating effects. Eruptions that take place infrequently on a human timescale are a good example since there is practically no memory of the consequences of past episodes [22]. The high uncertainty involved in forecasts of future eruptions tends to reduce people's perceptions of the risk [9,23], even impeding the emergence of a local risk culture, that is, the combination of knowledge and 'traditional' practices that can protect the population from hazards. Consequently, volcanologists generally believe that, in places where eruptions are infrequent, the local population systematically underestimates the risks associated with an eruption [24].

Despite having first-hand scientific information at their disposal, the authorities responsible for final decision-making also have their own biases. This is due to their midway position between experts and the rest of the population, who, in democratic societies, are also voters. Thus, the influence of possible political agendas in the authorities' approach to a potential risk should not be forgotten. The possible adoption of measures that might reduce vulnerability to a certain risk can be highly conditioned by the electoral cycle if strong social demands are voiced. At the same time, eruptions with a low recurrence rate can cause the authorities to play down the hazard in spatial planning decisions [9,25], giving priority to the short- and mid-term benefits of certain land uses in high-risk areas.

These different risk perceptions highlight the difficulties and challenges involved in risk governance in areas affected by volcanic

eruptions [26]. Bringing the risk perceptions of different agents more into line is crucial in the formulation of a risk governance strategy able to offer an adequate response to the challenges of an area with an active volcano. Without this minimal consensus, it is far more complicated to raise the population's awareness of the risks and to take steps to reduce a society's vulnerability – two basic factors in generating a risk culture tailored to the situation in question.

## 2.2. Neoliberal planning

Forward-thinking planning, managed through plans and legislative guidelines spanning periods of ten or more years, has steadily been replaced by more flexible planning, inspired by entrepreneurial visions of territorial change [27], in which an emphasis is placed on bargaining processes and public-private consortiums. This type of neoliberal planning can be traced back to the USA and the UK in the late 1970s; it then spread to the rest of the world. It is characterised by either a multiplicity of plans or an absence of them, often utilising projects and strategic designs (*master plans*) that can be adapted to fit the interests of private stakeholders in particular areas. This approach, where the state takes a step back, tends to result in fragmented interventions that are focused on specific areas and associated with market opportunities, e.g. events, public investment in infrastructure or catastrophes. This is a radical change from the basic concerns of Keynesian planning, which is far more heavily focused on creating conducive conditions for access to high-quality public services, goods, private services and decent housing for all. Nonetheless, it is important to note that, at a worldwide level, big differences can be observed in the intensity and speed at which these changes occur, and, on many occasions, there is a hybrid mix of political perspectives and planning approaches.

In this new context, urban development became mainly subject to the interests of what Logan and Molotch [28] describe as *local growth machines*, coalitions of elite local groups that regard land and the built space as goods from which the maximum capital gains can be harvested. These elites are landowners, real estate developers and certain entrepreneurs, in addition to other bodies who benefit directly from the expansion of urban growth, such as banks [29]. Since the triumph of neoliberal urban development involves the elimination of a large part of the restrictions on land use and land development imposed by post-war Keynesian and functionalist thinking, these elites can aspire to maximise their profits, as occurs with the capitalist models based on real estate and tourism development that prevail in a large part of southern Europe's peripheries.

Hence, when the aim is to tackle urban development in a way that takes into account the risks of extreme natural events, local elites tend to reject the idea because it jeopardises capital gains. Indeed, what they wish is 'to be able to build what they want, wherever and whenever' [10], counting on the political authorities, on most occasions, to help them do so. Some part of the population not made up of these elites also tends to oppose these plans, considering that they may raise the price of property, affect their right to use it at will or jeopardise economic development and employment creation. Consequently, in practice, given the difficulties that stem from a deep-rooted culture of private property and a desire to maximise profits, risk-prevention-oriented planning is easier said than done.

At the same time, reconstruction should be regarded as a window of opportunity for structurally reducing the vulnerability of societies exposed to risks [30] since the impacts of a disaster are so great that it is simpler to raise true awareness of the risk [11]. However, there are also unprecedented opportunities for the application of neoliberal political agendas, which might reproduce or even increase vulnerability in the event of future catastrophes, also exacerbating socioeconomic inequalities, as outlined by Naomi Klein [31], who coined the concept 'disaster capitalism'.

## 2.3. The case of small islands

The easiest, most effective way of minimising the volcanic risk is to prevent settlements and economic activities in areas more exposed to hazards. However, on most small islands, this option is practically unfeasible. On the one hand, a large part of the population and economic activities are already located in places with greater exposure to hazards, particularly when eruptions have rarely occurred over the course of history [32], with all the obvious relocation problems that this implies. Most of the affected population regard relocation as being synonymous with being uprooted since they would have to abandon their everyday social relations and lifestyles [33]. An island's limited surface area also means that there are fewer totally risk-free areas, and so if areas at some risk are ruled out, this could compromise any economic growth strategy, as pointed out in the case of the French Caribbean island of Martinique [34].

This is why the choice that tends to be made is to live with volcanic hazards, accepting them as part of life, although measures are taken to reduce the vulnerability of the population [35], with greater or lesser effectiveness. With this option, which goes hand in hand with a commitment to avoid the island's abandonment, even greater importance is attached to land-use planning. Probably one of the best examples of such risk management is the volcanic island of Faial (Azores, Portugal). Following the 1998 earthquake, the regional government opted for a strategy based on two main criteria: reinforcing the seismic resistance of buildings on the island and partially restructuring population settlements, limiting construction in areas that might be affected by landslides, active earthquake faults and floods. In this last case, this meant abandoning some areas of the island, relocating the affected population and reclassifying land previously rated as developable [36].

However, this example is almost unique and there are usually considerable difficulties in proceeding in this way, not only due to the opposition of local elites, who see their chance of enrichment decreasing, but also as a result of objections by local residents, who reject any change in what they regard as traditional settlement patterns. In some cases, the impact of the catastrophe associated with the eruption is of such a magnitude that it spontaneously leads to a relocation of the population and economic activities, as happened in Martinique after the 1902 eruption [37]. However, on most volcanic islands, the volcanic risk is not usually taken into account when planning and organizing land use, as can be seen in the cases of Tenerife [38], Ischia [39] and St. Vincent [32,40], to give just a few

examples of islands with very different socio-political contexts.

### 3. Methodology and sources

This paper analyses the planning and land use measures adopted in La Palma concerning the recovery and reconstruction after the eruption. The objective is to verify whether the window of opportunity opened by the eruption and the associated catastrophe has been used to lay the foundations for a land-use model that reduces vulnerability to future eruptions. It uses the island as a case study of post-catastrophe reconstruction planning and risk governance. Given the multidimensional nature and spatial variability of volcanic risks, an exhaustive analysis of underlying social and natural conditions and processes is needed. This is why case studies of specific places and socioeconomic and cultural contexts have become a fundamental method in this kind of research [41]. This paper also focuses on the urban and spatial planning strategy used during the post-catastrophe phase, in which neoliberal policy practices prevail. These practices are always 'based on contextually specific strategies' [42], and so local case studies are at the most appropriate scale to shed light on their spatial and temporal specificities [43].

Qualitative research methods have been used, mainly the analysis of the different versions of the decree-law that was to guide the spatial planning of Valle de Aridane after the eruption, drawn up by the Government of the Canary Islands between January 2022 and March 2023. This analysis has been extended to the documentation provided in each of the public presentations of the decree-law and to the technical documentation related to the reconstruction process produced by the different services of the regional administration during the process (Table 3).

It is, therefore, a methodology based on document analysis: a systematic procedure of reviewing or evaluating different types of documentary material, both printed and electronic. It requires examining and interpreting the information contained in the documents in order to extract meanings, to understand them and to derive valuable empirical knowledge for the research. It involves an initial skimming, followed by close reading and finally interpretation [44]. It is an iterative process, which allows the information to be organised into categories related to the central questions of the research (in this case, the role assigned to volcanic risk in the future spatial planning of Valle de Aridane). This has made it possible to understand the changes between the different versions of the decree-law and the greater or lesser consideration of volcanic risk in the different proposals.

This was combined with semi-structured interviews in order to cross-check some issues arising from the analysis of the documentation. Two were conducted with key informants linked to the public company GESPLAN and the Spanish Geological Survey (IGME), and a third was conducted with the Regional Minister for Agriculture of the Government of the Canary Islands between 2019 and 2023. Interviews with other key informants and policy makers were attempted but proved impossible. In order to fill this gap, intensive monitoring of the local media, especially the analysis of interviews with representatives of the affected people and policy makers, was of great interest. Finally, the academic literature on volcanic risk in La Palma was also reviewed, as well as the role of volcanic risk in different island planning documents.

The lead author of this paper is from the municipality of Los Llanos de Aridane, where he has lived for a third of his life and with which he has close family ties, causing him to make frequent visits. Therefore, in social sciences, he is considered as an 'insider' who researches his own local reality. Obviously, this position has advantages and disadvantages from a research point of view [45,46]. In this case, an obvious advantage is that he has extensive empirical knowledge of the social, political and economic realities of La Palma and the area most affected by the recent eruption. Hence, his own life experience allows him to understand some of the dynamics and practices of island society, such as the lack of compliance with urban planning regulations and the dominance of certain ideas in the collective imagination of that society, which are of obvious interest for this research. Of course, it also has disadvantages, such as difficulties in gaining access to potential interviewees who would be willing to talk to a stranger but not to someone they feel is part of their community.

### 4. Valle de Aridane: a brief presentation

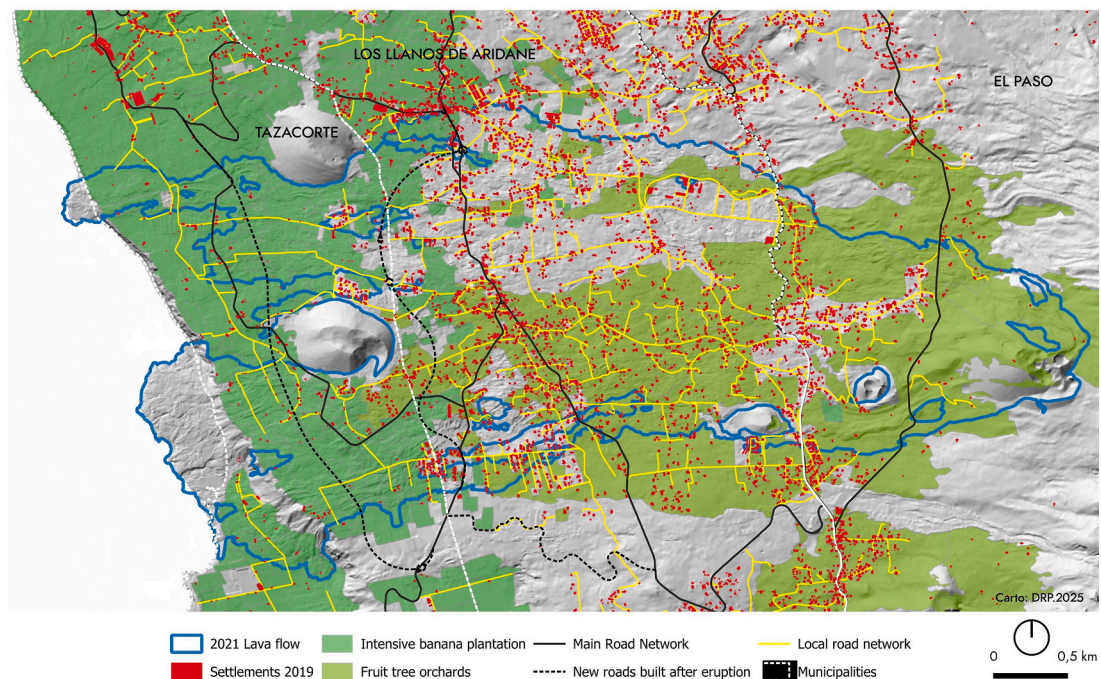
#### 4.1. A complex spatial makeup

The lava flow from the eruption in La Palma that took place between September and December 2021 covered an area of 1219 ha, 1.72 % of the island's total surface area of 708.3 km<sup>2</sup>. In this small area, there were 2329 inhabitants (2.8 % of the island's total inhabitants) and 1161 tourist beds (6.1 %), the road network totalled 74 km (5.5 %) and there were 1562 dwellings (3.3 %) and 370 ha of crops (4.8 %) (Fig. 2). These figures highlight the density and socio-economic complexity of the area concerned. In fact, these data make the considered eruption one of the most devastating eruptions for which detailed records exist of the impact of lava flows on infrastructure and buildings [47]. This big impact, despite the small surface area that lies buried under the lava, is due to the fact that the lava flow crossed the island's most economically dynamic area. Although Valle de Aridane has managed to conserve some classic rural features due to the predominance of agricultural activities, the logic and dynamics consistent with suburban spaces are particularly observable, brought about by various economic changes since the mid-20th century [48–50].

The first of these changes was the development of intensive farming, associated with exports of bananas, between the 1950s and 1970s. The growth of economic activity and population associated with the boom in this activity, together with the first influx of foreigners from North-western Europe settling in housing estates and isolated dwellings [48], led to an intensification of the pre-existing dispersed settlement [50]. It was further accentuated by the second economic change, tied to the development of tourism starting in the late 1980s with the arrival of the first charter flights to La Palma from Germany. From then on, a substantial amount of tourism accommodation was built on rustic land, located here and there in isolated dwellings, taking advantage of the outstanding

**Table 3**  
Main documentary sources used.

Document	Description
Local media	- Digital local newspapers: <i>La Palma Ahora</i> ; <i>El Apurón</i> ; <i>El Periódico de La Palma</i> ; <i>El Time</i> ; <i>El Valle de Aridane</i> - Daily printed newspapers (province): <i>Diario de Avisos</i> ; <i>El Día</i>
Laws (approved and drafts)	- Local radio stations: <i>COPE La Palma</i> ; <i>Radio La Palma Cadena SER</i> ; <i>Onda Cero La Palma</i> ; <i>7.7 La Palma Radio</i> - Decree-law 9/2023, 18 December, of territorial and urban planning measures for the economic and social recovery of La Palma following the volcanic eruption of Cumbre Vieja - Decree-law 3/2024, 11 March, of agricultural measures for the economic and social recovery of La Palma following the volcanic eruption of Cumbre Vieja - Decree-law 2/2024, 11 March, adopting urgent measures on social housing for the economic and social recovery of La Palma following the volcanic eruption of Cumbre Vieja - Draft decree-law to restore housing conditions to their normal conditions on La Palma following the volcanic eruption of Cumbre Vieja. (version 6: February 08, 2023; version 7: March 17, 2023; and version 8: July 07, 2023) - Draft decree-Law on the restoration of agricultural conditions on La Palma following the volcanic eruption of Cumbre Vieja (version 1, April 28, 2023) - Decree-law 1/2022, 20 January, on urgent urban planning and economic measures for the building or rebuilding of main residences affected by the volcanic eruption on La Palma
Public presentations of the decree-law (slides and videos)	- Presentation of the <i>Post-eruption spatial framework for restoring normality in La Palma</i> (Planning Proposal, version 1, July 18, 2022) - Conference on <i>Post-eruption spatial framework for restoring normality in La Palma</i> . Proposals from spatial planning for a lasting social, economic and environmental recovery (October 20, 2022) - Presentation of the Decree-Law Draft and the Planning Proposal (version 6, January 20, 2023) - Presentation of the Planning Proposal Within Lava Flows (version 6, January 20, 2023) - Presentation of the Planning Proposal Outside Lava Flows (version 6, January 20, 2023) - Presentation of the Decree-Law Draft and the Planning Proposal (version 8, July 04, 2023)
Spatial planning	- La Palma Land Use Plan (PIOLP) - La Palma Special Risk Prevention Plan (PTEPR-LP)
Technical reports related to decree-laws	- Report on the buildings and plots affected in the area of the lava flow. Diagnosis of buildings - Social Intervention Report - Scientific Expert Criteria Reports for the <i>Post-eruption spatial framework</i> . - Maps resulting from the scientific work within the <i>Post-eruption spatial framework</i>



**Fig. 2.** Built-up area covered by lava flows in 2021 eruption.

SOURCE: The authors, using QGIS, based on the La Palma spatial plan ([https://services.arcgis.com/hkQNLKNeDVYBjvFE/arcgis/rest/services/PIOLP\\_Usos\\_del\\_Suelo/FeatureServer/0](https://services.arcgis.com/hkQNLKNeDVYBjvFE/arcgis/rest/services/PIOLP_Usos_del_Suelo/FeatureServer/0)), Spanish Cadastre (<https://www.sedecatastro.gob.es/>) and the Local Infrastructure & Services Survey (<https://visor.grafcan.es/visorweb/default.php?svc=svcEIEL>).

scenic and climatic qualities of the island. The tourist flows were accompanied by a bigger stream of migrants to the island from the tourists' main countries of origin, primarily Germany, with a large number settling in Valle de Aridane.

With both of these changes, Los Llanos de Aridane grew as a town. Today, it has over 12,000 inhabitants and, together with the island capital, it plays a key role in La Palma's urban network. Despite its small size, it evolved from a farming town dependent on bananas to an urban centre with commercial functions and services whose catchment area covers the whole of the west of the island. As part as this process, a large area of scattered settlement was developed to the south of the town (Fig. 3), where, in addition to different economic activity units, a great number of homes were built, given the lack of housing in the town. This explains why 74 % of the plots that were buried under the lava were used for residential or tourism purposes, and 91 % of them had detached single-family homes. Furthermore, most of them also had an orchard surrounding the dwelling, resulting in 72 % of the residential plots being larger than 1000 m<sup>2</sup>, which is also evidence of the highly dispersed nature of the settlement [51].

The lack of discipline in the urban planning of Valle de Aridane's three municipalities over the decades, the wide social diffusion of the automobile and the elimination of restrictions that prioritised the use of rustic land for agricultural purposes following the approval, in 2002, of the first law on specific measures for the spatial planning of tourism on the islands of El Hierro, La Gomera and La Palma [52], all helped to encourage this scattered settlement. These factors also help to explain why, despite the low rate of demographic change in Valle de Aridane [53] (Fig. 4), there was increasing land artificialisation: while the population rose at a rate of 10.6 % from 1987 to 2006, artificialised land grew at a rate of 94 % for the same period.<sup>1</sup> To paraphrase Tierney [10], it might be said that, in Valle de Aridane, people have built whatever they want, wherever and whenever.

#### 4.2. Volcanic risk

On La Palma, two main volcanoes can be distinguished: Taburiente, an inactive volcano occupying the north part of the island; and Cumbre Vieja, a ridge with characteristics typical of an ocean island rift zone, occupying the other two thirds of the island. All the historical and pre-historical eruptions were concentrated solely in Cumbre Vieja [54,55]. Historical records of eruptions, including witnessed ones and those documented by human beings, date back to 1470 in La Palma (Table 1). That is, in just over 550 years, there have been eight eruptions there, half of the total eruptions recorded for all the Canary Islands. Furthermore, in five of the eight cases, the lava flows ended up by running down the western slope of Cumbre Vieja, affecting Valle de Aridane to a greater or lesser degree. Consequently, it is very likely that a new eruption will affect this area once again, as highlighted in different hazard studies (Fig. 5), even though their results do not fully coincide.

What is more, the possibility is not so far away in time. In 2015, Martí et al. [25] considered a timeframe of 20 years and predicted that there was a 74.4 % chance of a new eruption in La Palma. Pérez Rodríguez [58] recently stated that, following the 2021 eruption, there is a 48.7 % likelihood of a new eruption on the island in the next 50 years, a 73.6 % likelihood if a timeframe of 100 years is taken and a 93 % likelihood if we consider a timeframe of 200 years.

There are also risk factors associated with the recent eruption in Valle de Aridane that must be taken into close account in any intervention on the surface of the lava. From recent studies of the area affected by the lava, the following was found.

- High temperatures persist in a large part of the lava field, with estimated cooling times of more than a decade [59].
- There are evident difficulties for the foundation of buildings on the lava flow [60], and interventions are not recommended in areas with a thickness of more than 5 m (Fig. 6).
- There are active fault lines [61]. This increases the geotechnical risks, making it inadvisable for new buildings to be constructed on some parts of the edges of the lava flow, while also requiring the limitation of residential uses along other parts.

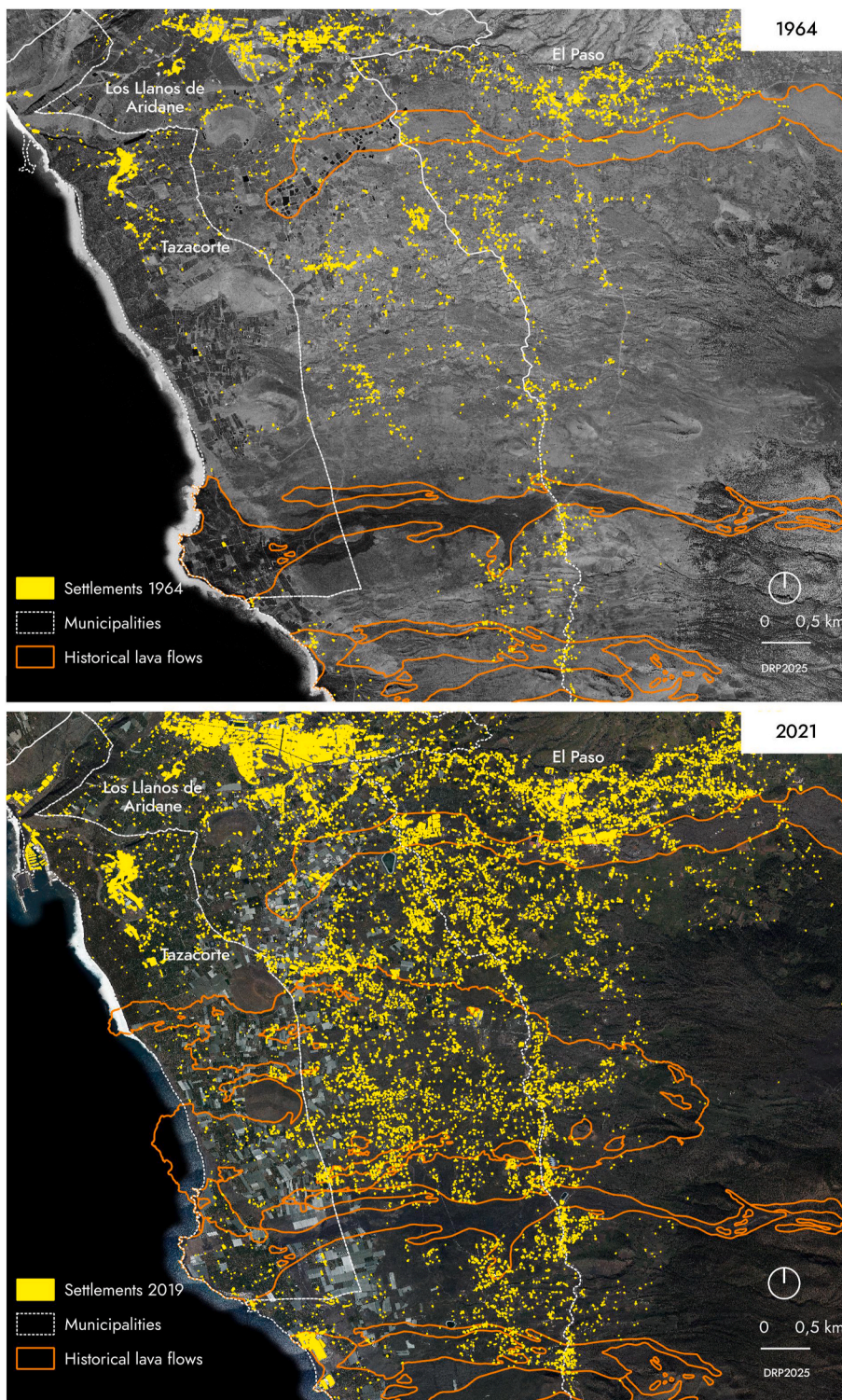
The eruption also showed that scattered settlement is a factor that increases vulnerability as it leads to a notable rise in the surface area where dwellings might be affected and it slows down the evacuation process along a network of narrow roads and private rights of way [62]. This dispersed settlement of Valle de Aridane, organised by a network of intricate roads and highly dependent on motor vehicles, has continued to intensify in recent decades.

#### 4.3. The need to shift the spatial settlement pattern

The devastating effects of the volcanic eruption and the scientific evidence that the whole of Valle de Aridane is very likely to be affected by new lava flows from future eruptions (Fig. 5), more than justify the consideration of volcanic risk when addressing land use and urban planning in a post-disaster scenario, especially if the objective is to reduce vulnerability in the future.

As Troll et al. [9] note, because most eruptions have taken place at moments in history when the lava flows covered areas with few inhabitants, this induced the population to believe that eruptions on La Palma are not especially destructive, and so they underestimated the real risks which were confirmed in 2021. Even a destructive eruption, like the 1949 San Juan volcano eruption, has come to be viewed as a minor catastrophe despite the fact that, given the demographic and economic background context of the affected area, its impact was far higher than local people think [2]; hence, there is a need to highlight the risk and to take it into account in planning documents in order to minimise the potential damage caused by future events.

<sup>1</sup> Artificial surface data for municipalities, urban areas, provinces and self-governing regions can be found on the Digital Atlas of Spain's Urban Areas at <https://atlasau.mitma.es/>.



**Fig. 3.** Evolution of the scattered settlement of Valle de Aridane (La Palma).

SOURCE: Orthophotos of La Palma taken in 1964 and 2021, available at Infraestructura de Datos Espaciales de Canarias ([https://www.idecanarias.es/listado\\_servicios](https://www.idecanarias.es/listado_servicios)). Information on settlements obtained from the Spanish Cadastre (<https://www.sedecatastro.gob.es/>). Created using QGIS.

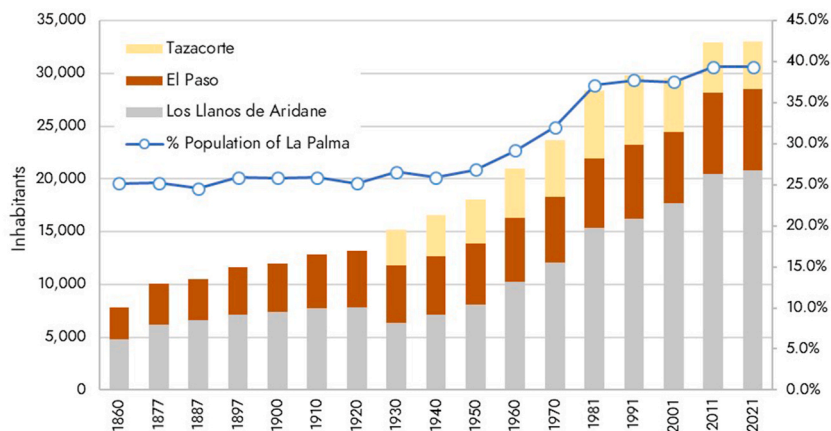


Fig. 4. Evolution of Valle de Aridane's population (1860–2021).

SOURCE: Canary Islands Institute of Statistics (ISTAC): *Historical evolution of the population of the Canary Islands from 1768 to the present*. Available at <https://www.gobiernodecanarias.org/istac/estadisticas/demografia/poblacion/cifras censales/C00025A.html>

The way to do this is to significantly alter the spatial settlement pattern. Consequently, the best option from a spatial planning perspective seems to be avoiding new settlements and minimising the creation of infrastructure and basic services on the recent lava flow and to the south of it. This is possible, as the population who lost their first homes could be accommodated in new housing to be built on land available for urban development in the towns of the three affected municipalities. In fact, the latest available estimates show that the spatial planning in force in the three municipalities of Valle de Aridane, would allow the building of 5014 dwellings, most of them in or close to the town centres [63].

The head of the Island Council's Spatial Planning Service put this clearly in a recent publication, stating that [64]:

[...] the strip of land that contains the main towns of Valle de Aridane's three municipalities is the best place to accommodate people and for the location of economic activities after the eruption. The spatial planning activities that are needed to do this are an opportunity to lay the foundations of a model that fosters more efficient use of natural resources, improves the health and wellbeing of local residents, and helps to mitigate, adapt to and foster resilience to climate change.

This strip (Fig. 7) is a space outside the lava flow, where some studies indicate that the hazard associated with a new eruption might be lower (Fig. 4A and B). A more compact pattern of land occupation would be adopted, giving priority to undeveloped land already contemplated in urban plans in the vicinity of the three towns, since this would help to reduce the vulnerability of the population in the event of a new eruption. There would be less use of the scanty rustic land still available after the eruption, and this would encourage public transport instead of private vehicles. The town of Los Llanos de Aridane's existing ring road and the one envisaged for El Paso would act as a boundary to contain the southern overflow of the urbanisation.

## 5. The spatial planning proposals for Valle de Aridane

### 5.1. An initial solution to the situation with structural effects

When the eruption was over, the Government of the Canary Islands passed decree-law January 2022 on urgent urban planning and economic measures for the building or rebuilding of main residences destroyed by the lava flow [65]. The law, which underwent successive amendments, allowed those who had lost their first home to build another on any plot they owned on urban land or rustic land authorised for new settlements. If this was not possible, they could also do this on ordinary rustic land or rustic land protected for agricultural or scenic purposes, with the elimination of existing restrictions on the construction of first homes on this kind of land in this particular circumstance.

In the context of growing pressure by citizens due to the lack of available housing, the decree-law was unanimously ratified by all the political groups in the Canary Islands parliament. The decree-law, which was conceived to act as a provisional solution, has ended up by conditioning subsequent planning in Valle de Aridane by encouraging a dispersed settlement that ought to have been contained in order to reduce vulnerability to volcanic hazard. Indeed, under this decree-law, building permits were granted to 152 homes up until March 2023, with the addition of another 97 through to January 2024 according to the president of the Island Council, leading to a total of 249 new scattered dwellings [66].

This number will grow substantially in the coming years, following the latest amendments to the decree-law in December 2023 and the extension of its validity from the original eighteen months to four years. Its scope of application was also extended from first homes to all residential uses, including second and holiday homes. Furthermore, in order to build on ordinary or protected rustic land in municipalities not affected by the eruption, it is no longer necessary to have owned a plot there prior to the eruption [67]. Both the original decree and its amendment were politically justified by the difficulties in finding land for development in the three affected

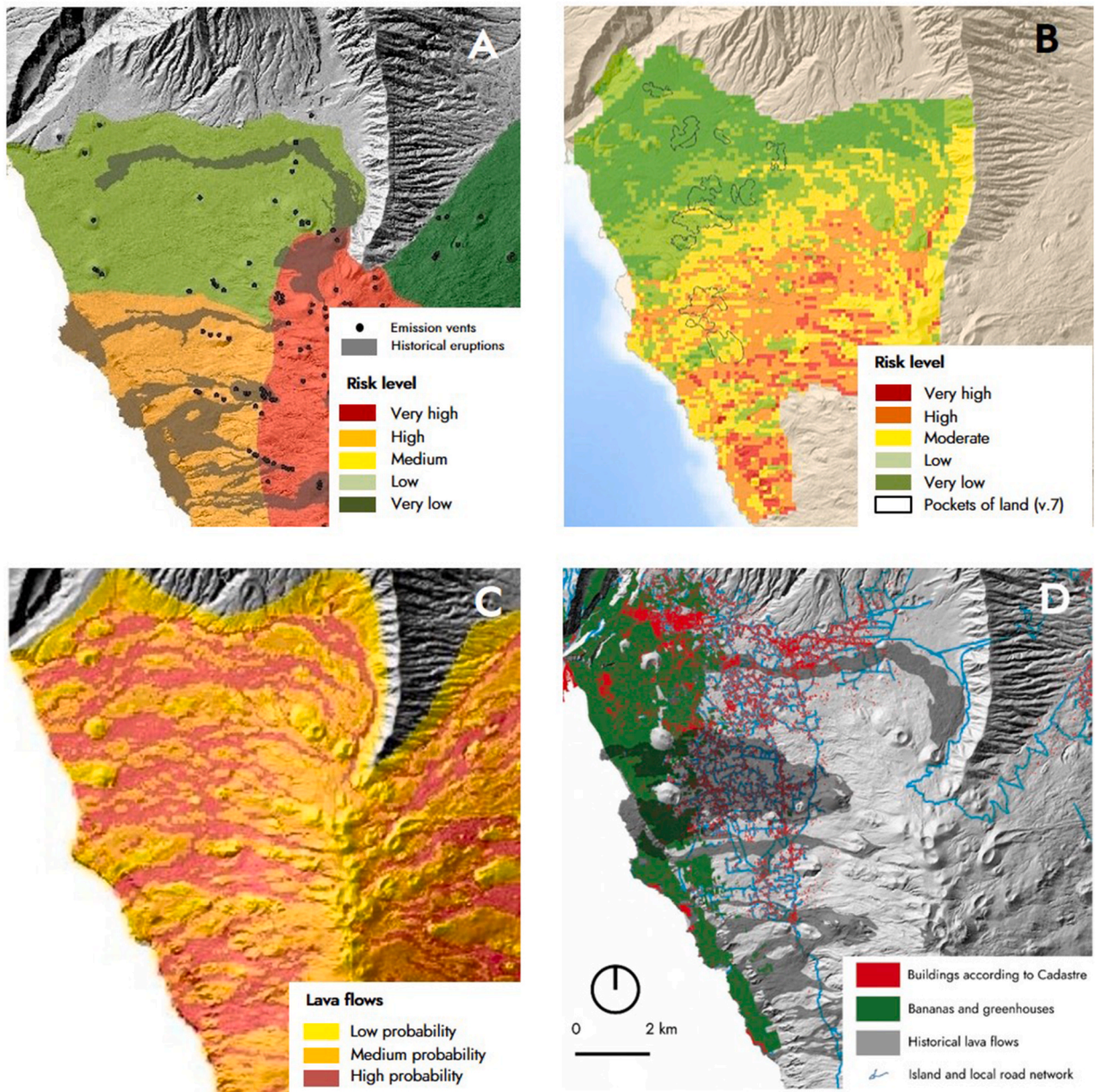


Fig. 5. Evaluation of the volcanic hazard evaluation in Valle de Aridane according to different studies (A, B and C) and the distribution of the main properties that might be affected (D).

SOURCE: (A) Reproduction from the preview version of La Palma Volcanic Risk Action Plan (PAIV): [https://villademazo.com/wp-content/uploads/2021/10/Folleto\\_ciudadania\\_PAIV.pdf](https://villademazo.com/wp-content/uploads/2021/10/Folleto_ciudadania_PAIV.pdf). (B) Reproduction of map featured in [56]. Original map elaborated by [57]. (C) Reproduction of map featured in [25] under license CC BY-NC-ND 4.0. (D) Drawn up by the authors, using QGIS, based on the La Palma spatial plan ([https://services.arcgis.com/hkQNLKNeDvYBjvFE/arcgis/rest/services/PIOLP\\_Usos\\_del\\_Suelo/FeatureServer/0](https://services.arcgis.com/hkQNLKNeDvYBjvFE/arcgis/rest/services/PIOLP_Usos_del_Suelo/FeatureServer/0)), Directorate General for the Land Registry (<https://www.sedecatastro.gob.es/>) and the Local Infrastructure & Services Survey (EIEL, the acronym for the name in Spanish (<https://visorweb/default.php?svc=svcEIEL>))

municipalities. However, as we saw, there was no lack of land for new urban development in these municipalities. The real problem was that the characteristics of the land or the type of settlement that could be built on it did not meet the expectations of a majority of the affected population.

### 5.2. A spatial framework for restoring normality in La Palma: two different visions

Beyond the urgent and short-term solution provided by decree-law 1/2022, the Regional Government of the Canary Islands

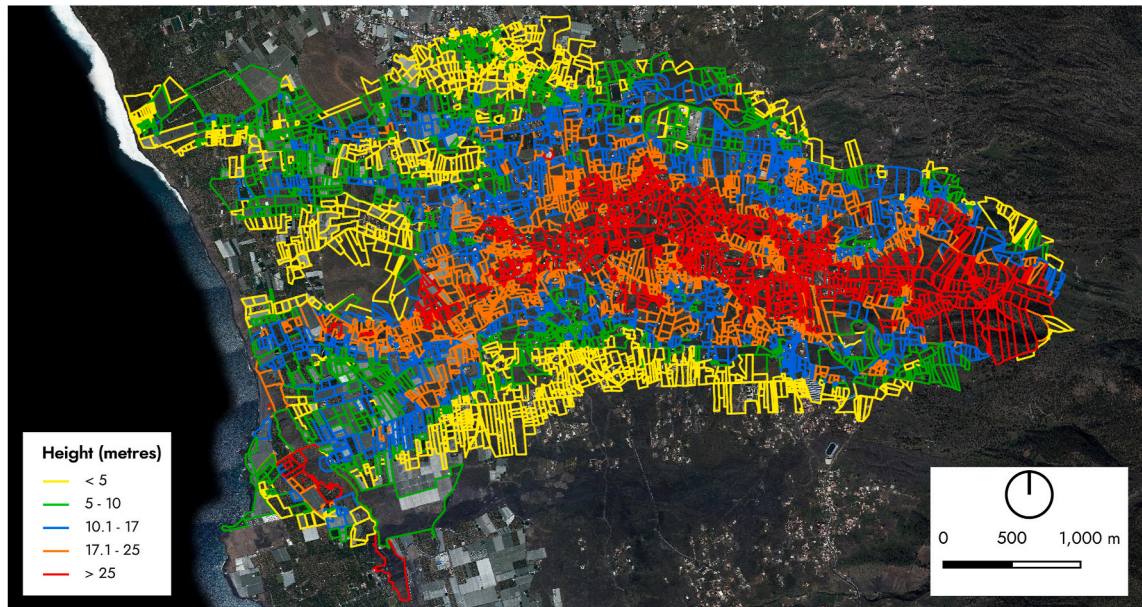


Fig. 6. Average height of the lava flow from the 2021 eruption on each affected land registry plot.

SOURCE: Based on data available at IDE Canarias: [https://idecan1.grafcan.es/ServicioWMS/MDT\\_LP2022?request=getcapabilities&service=WMS](https://idecan1.grafcan.es/ServicioWMS/MDT_LP2022?request=getcapabilities&service=WMS)

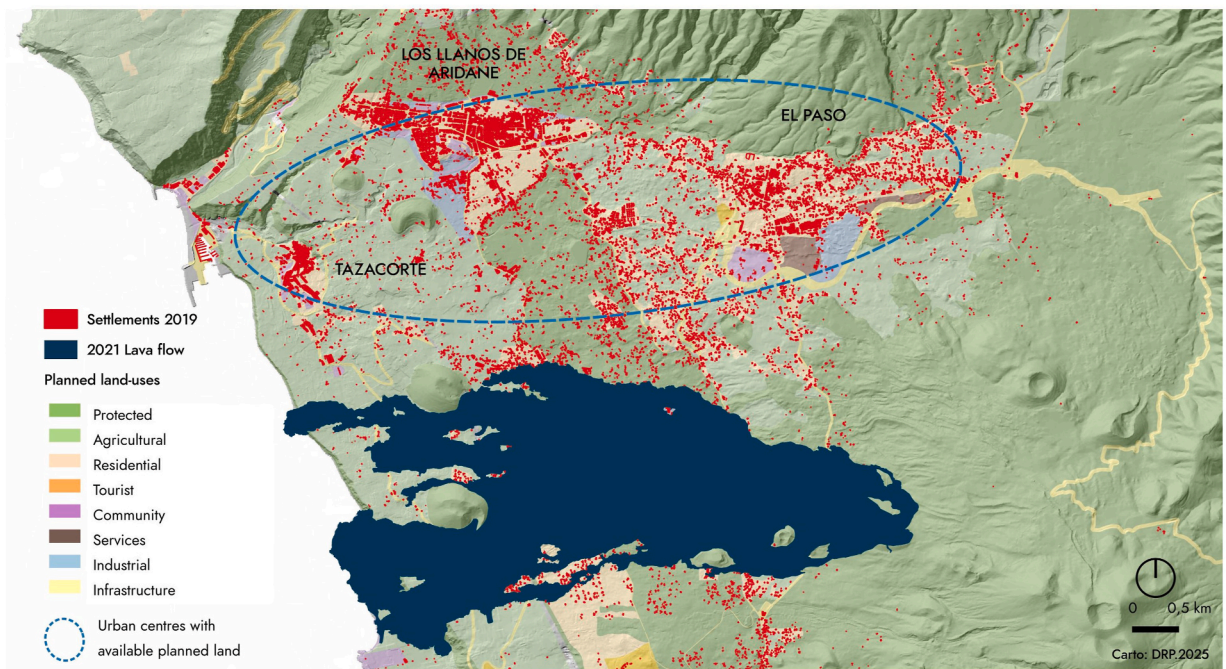


Fig. 7. The most suitable area for resettlement.

SOURCE: Based on a map featured in [64]. Information on settlements obtained from the Spanish Cadastre: <https://www.sedecatastro.gob.es/>. Information on planned land-uses obtained from IDE Canarias (global uses): [https://www.idecanarias.es/listado\\_servicios/planeamiento-vigente](https://www.idecanarias.es/listado_servicios/planeamiento-vigente). Created using QGIS.

considered that it was convenient organizing a process for restoring normality in Valle de Aridane through a spatial planning document with an overall vision for the region. Therefore, once the eruption was over, the Regional Government (the first centre-left government since 1987<sup>2</sup>), promoted a *Post-eruption spatial framework for restoring normality in La Palma (the framework in short)*. It is likely that it was first conceived to act as an ambitious supra-municipal planning document for the whole of Valle de Aridane, capable of defining a stable and integrated *framework* for post-catastrophe spatial interventions. Although this would have been an appropriate choice, and the one that some of the planners involved had in mind, as noted above, it was legally difficult to implement in practice.

If we take into account current urban planning legislation in Spain, the municipal level is basic for spatial planning and is the sole responsibility of the local governments. Likewise, there were serious doubts that the exceptional legal situation created by the eruption, which allowed the approval of numerous pieces of legislation using the emergency procedure, could justify an action of this nature that went much further than offering a solution to those affected. But the particular interests of the different municipalities involved also played an important role in preventing possible joint planning. Finally, the need to offer a rapid solution to those affected was in clear contradiction to the time involved in the preparation and approval of spatial planning documents. Thus, *the framework* ended up being mostly a tool to promote the recovery of a certain residential, industrial and agricultural normality in the region. Hence, legally speaking, the process was approached through the drafting of three decree-laws for each of the fields under consideration (residential, agricultural and industrial), although the first would play a key role in the resulting spatial model, given its urban planning nature.

Regarding residential normality, *the framework* was originally the result of two different technical visions of the solution that should be adopted to resolve the needs of the population damaged by the eruption. On the one hand, the proposal was led by the three concerned municipalities through their technical urban planning offices and the public company GESTUR, which specialises in the creation of urban land for residential, industrial or equipment developments. Its objective was to take advantage of the situation generated by the emergency to speed up, through the possibilities offered by the use of the emergency procedure to approve legislation related to recovery, the development of large pockets of land in the three municipalities that had never been urbanised [68]. Seven locations were planned, totalling 191 ha, allowing the construction of 6166 dwellings capable of accommodating more than 15,400 inhabitants (Fig. 8). These figures seem to correspond to a bid to make the population gradually migrate upwards toward the north of Valle de Aridane, simultaneously leading to a change in the predominant type of housing, since single-family homes only account for 17 % of the total planned.

On the other hand, according to planners from GESPLAN -another public company of the Government of the Canary Islands, dedicated to integrated spatial planning and with previous experience in post-eruption recovery on the island of Fogo (Cape Verde)- the recovery of residential normality should be mainly limited to solving the problems faced by those affected, adopting an approach that would fit in with a recovery strategy inspired by international guidelines (Table 4): the World Bank's *Building Back Better* approach [70], civil society participation advocated by the *UN Sendai Framework* [71] and sustainable urban planning principles.

Thus, a process of social participation to assess post-disaster needs and discuss alternative spatial interventions with the affected parties within a context of necessary risk reduction was launched. It was clear that most of the participants wished to replicate the previous settlement pattern, recovering the predominant single-family homes with a kitchen garden. Despite the low number of affected people who took part in the process, since the different sessions were never attended by more than 21 % of the invited population [72], we should not forget that this was the opinion shared by most members of associations of affected residents. Therefore, for GESPLAN, a limited intervention inside the lava flow, especially at the edges, was the right choice.

Both proposals coexisted, formally presented as a single project, until the seventh version of the draft of the residential decree-law (Table 5 and Fig. 8). For this purpose, areas of developable land were defined, both inside and outside the lava flow, in order to re-house the affected population through land swaps [69]. As with the concentration of agricultural land [73], this process would be organised by a *Management Agency for the Recovery of Normality in La Palma* (AGESNORM), a public consortium from the Autonomous Region of the Canary Islands.

Through this consortium, urbanised undeveloped plots would be offered to the owners of land affected by the eruption, with a permitted floor area ratio equivalent to their previous property, providing that their buried property was given in exchange (Article 9.1). For property owners unable to build a new home with the aid they received, access to social housing was contemplated on land also identified in the decree (Article 10). Since this procedure involved the expropriation of earmarked land (Articles 9.3 and 9.4), compensation would be given in return (Article 9.5) or access to one of the new urbanised plots (Article 9.5); would be given in return, with this last case further complicating the matter.

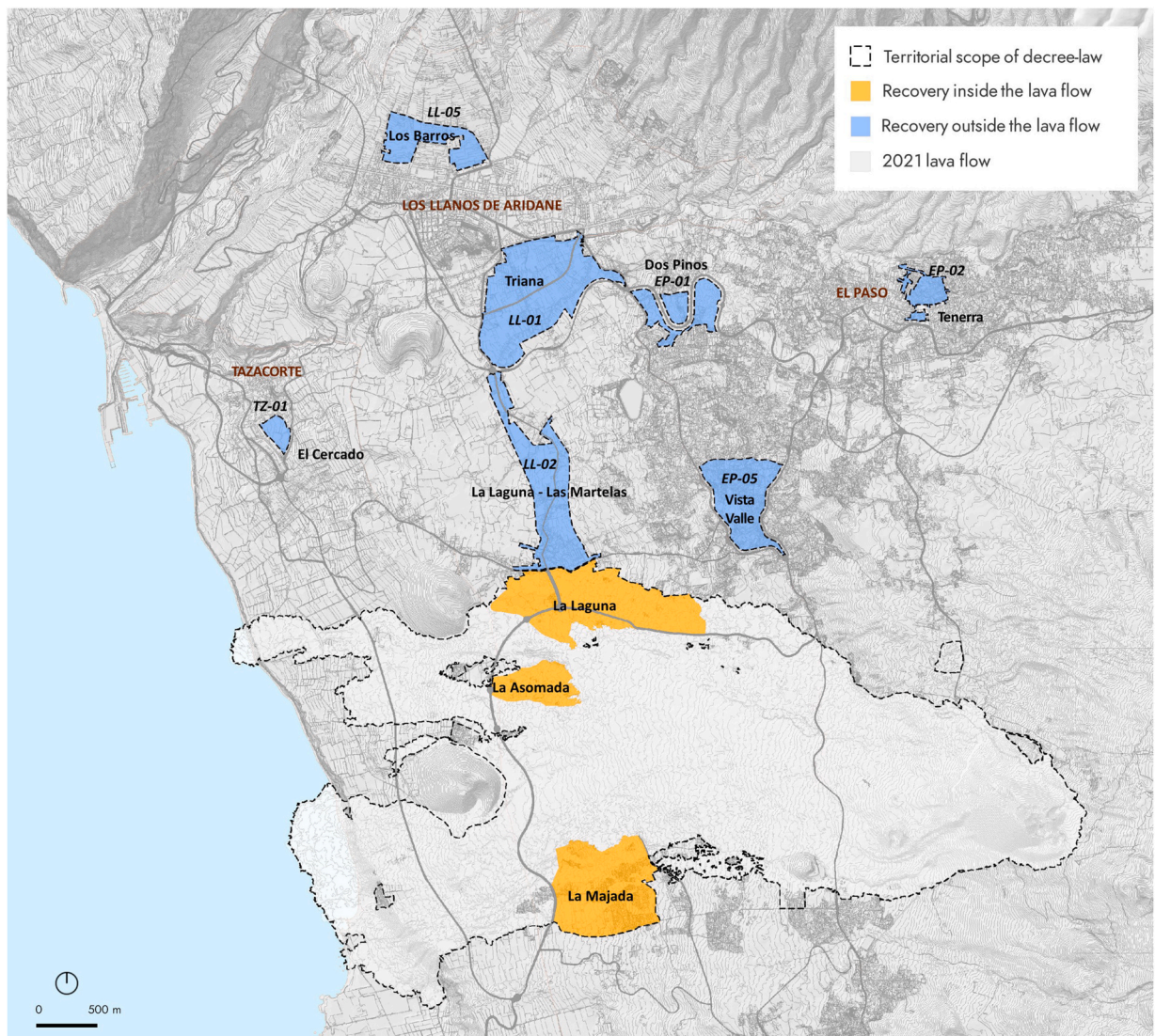
As much as possible, this proposal was aimed at preventing the population from settling in the most hazardous areas, defined through a multi-risk analysis involving different scientific institutions (IGME-CSIC, Involcan and University of La Laguna). Therefore, it limited the location of basic infrastructure and services on the lava flow, and restricted the type of economic activities that could be carried out there (Fig. 9). With the land readjustment process for agricultural and residential owners, the area would be better organised internally so as to ensure swift, safe evacuations in the event of an eruption. In the case of settlements, although single-family homes with kitchen gardens were permitted, the aim was to avoid scattered properties by locating the new plots and buildings around a series of axes to ensure a more compact pattern (Fig. 10). In this way, people wishing to recover their former lifestyle were offered the possibility of doing so, at least in part.

<sup>2</sup> The regional government was made up of five parties: PSOE (a state-wide centre-left party), Podemos (a state-wide left-wing party), Sí Se Puede (a nationalist left-wing party), Nueva Canarias (a regionalist centre-left party), and Agrupación Socialista Gomera (a splinter party of the PSOE in La Gomera). The PSOE was in charge of the Regional Ministry for the Environmental Transition, responsible for drafting the Spatial Framework.

Over 56 % of the lava flow is excluded from the process, either because it is a proposed protected area or because restrictions on any activity in the short or mid-term are required due to the high temperatures and geo-tectonic risks. Where the recovery of land is dependent on the lava cooling down, most of it will probably end up in the hands of the public authorities following land readjustment and land swaps. This means that not only can the amount of protected space be increased but also the vulnerability can also be reduced.

As for agricultural uses, mainly focused on banana growing, the proposal included the concentration of plots of land (Fig. 11), with the active participation of the regional government in the design of terraced farmland and the preparation of land for its cultivation. ASPROCAN, the umbrella association for organisations of banana producers in the Canaries, had already highlighted the advantages of this option, since better use could be made of the available surface area, with better adaptation to the terrain, more efficiently designed roads and basic infrastructure and an overall cost that would clearly be lower than that of restoring individual properties [75].

The eighth draft of the decree-law, which was made public in July 2023, abandoned the idea of speeding up the urbanisation of large pockets of land for residential use in the context of the post-disaster recovery [74]. The draft was presented by the centre-left regional government when it was carrying out acting governmental functions after being defeated in the regional elections of May 2023. However, its elaboration coincided with the pre-electoral period, which suggests that the rejection of the affected population of the pockets of land for residential use outside the lava motivated their elimination. Efforts now focused on a far less ambitious objective: the definition of sufficient land on the lava flow and its edges to carry out the process of land readjustment and land swaps envisaged in the seventh draft; thus, GESPLAN's technical vision prevailed. Given that the surface area of the lava flow where construction was technically feasible could only accommodate 753 houses according its proposal, the decree-law's territorial scope



**Fig. 8.** Territorial scope of recovered residential normality (versions 6 and 7).  
SOURCE: Reproduction of map featured in [69] with modifications by the author.

**Table 4**

Criteria governing the recovery of Valle de Aridane.

- Post-disaster recovery approached from the perspective of people-centred rights.
- Linkage between disaster management and governability, facilitating the prompt recovery of people's ways of life and livelihoods.
- A recovery process aimed at risk reduction.
- The involvement of all the public authorities in the post-disaster recovery process.
- Policies with a focus on sustainable development.
- A recovery process embedded in global management.

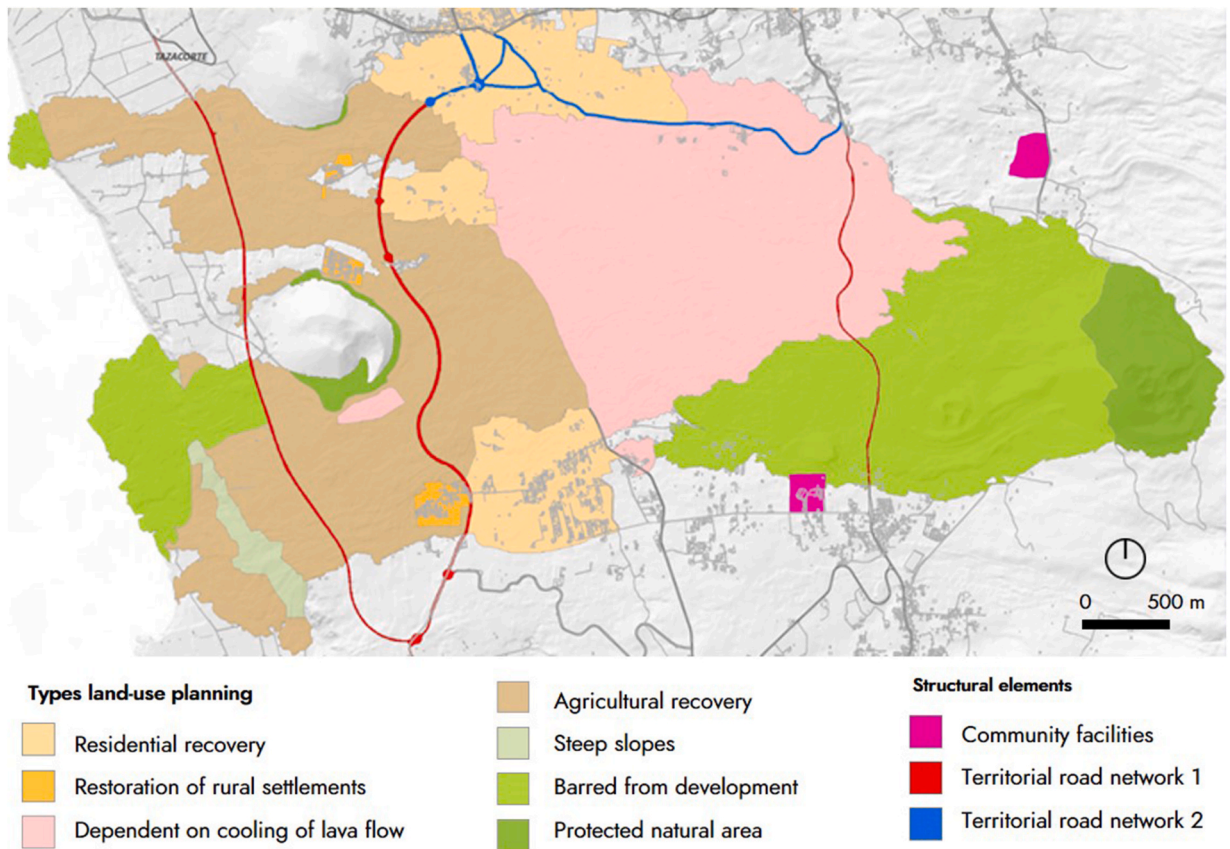
SOURCE: Goals and Objectives of the Spatial Framework, outlined at <https://lapalma.planderecuperaciondecanarias.es/prclp/>**Table 5**

Changes in the spatial planning proposal for Valle de Aridane.

Objective	Legislation	Dates	Government	Characteristics of the proposal
Urgent measures after the end of the eruption	Decree-law January 2022 on urgent urban planning and economic measures for the building or rebuilding of main residences affected by the volcanic eruption on La Palma.	In force from January 2022. Amended in 2024.	Centre-left (2022) and Right-wing (2024)	Allows those who have lost their first home to build another on any plot they owned on urban land or rustic land authorised for new settlements. They could also do it on ordinary rustic land or rustic land protected for agricultural or scenic purposes. Amended in 2024 to extend its scope to all residential uses, including second and holiday homes; and its 18-month validity to 4 years, to make it the main instrument used to achieve residential normality.
Post-eruption spatial framework for restoring normality in La Palma	Drafts 6 and 7 of the decree-law for the recovery of residential normality in La Palma	July 2022 to April 2023 (never passed)	Centre-left	Integration of two technical visions of recovery planning: (1) quick intervention outside the lava flow through the development of large pockets of land to build more than 6000 dwellings (City Councils and GESTUR); and (2) small residential and service provision projects inside the lava flow to resettle the majority of those affected (GESPLAN). Comprehensive solution for main housing and banana farms through re-plotting and swapping. The main difference between drafts 6 and 7 lies in the disappearance in version 7 of the detailed planning for the areas outside the wash that had been done in version 6. The existing municipally owned land was also incorporated in version 7.
	Draft 8 of the decree-law for the recovery of residential normality in La Palma	July 2023 (never passed)	Centre-left	The recovery of residential normality through interventions on the lava flow and the definition of land for the construction of social housing in the three towns. It maintains re-plotting and swapping, but avoids defining plots of land outside the lava flow for this purpose, as it is understood that the change in the spatial pattern of occupation should be dealt with through the ordinary planning mechanisms.
Measures for the economic and social recovery of La Palma	Decree-law September 2023 on spatial and urban planning measures for La Palma Decree-law February 2024 on urgent measures on social housing for La Palma Decree-law March 2024 on agricultural measures for La Palma	December 2023 to March 2024 (In force)	Right-wing	The replication of the situation prior to the eruption as the temperature of the lava flow drops, disregarding the volcanic risks. Land readjustment processes for residential and agricultural purposes are eliminated. The reconstruction of destroyed buildings and buried property in areas with lava under 10 m thick is authorised. Plot-owners of houses or agricultural land under lava more than 10 m thick will be included in a future decree-law on housing.

NOTE: Only the latest drafts of the decree (6, 7 and 8) and its final version are analysed, since the previous ones lacked enough development for its effective approval. See footnotes 2 and 3 for an explanation of the composition of regional governments.

SOURCE: The authors, based on different draft versions of the published decree-law.



**Fig. 9.** Structural planning inside the lava flow (version 7).  
SOURCE: Reproduction of map featured in [69].

incorporates seven areas of public land destined for the construction of social housing, located in the towns of the three municipalities.

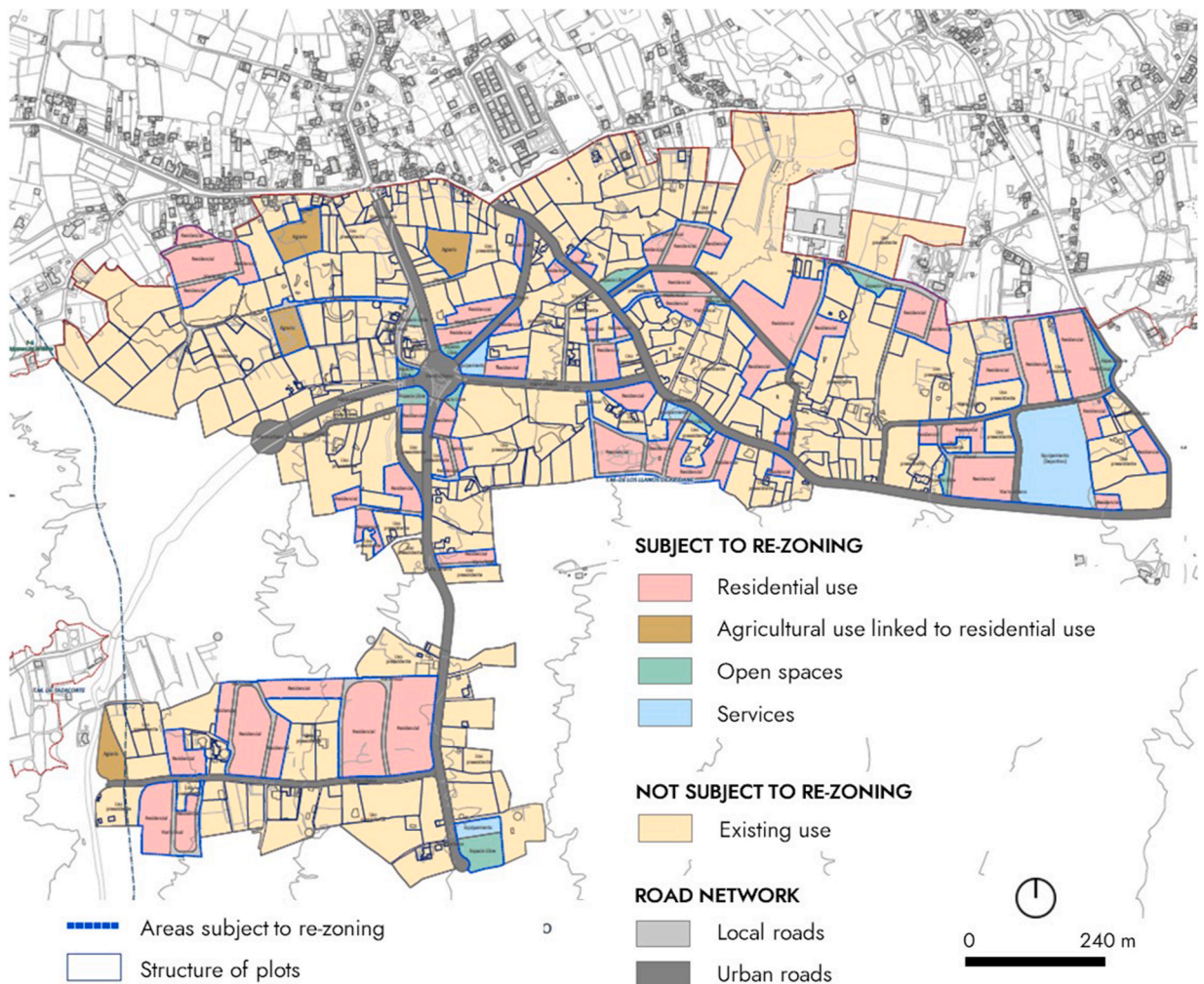
### 5.3. A final spatial planning model that replicates the original situation

Policies related to the spatial planning of Valle de Aridane changed substantially after the May 2023 elections, which resulted in a new majority in the Canary Islands Parliament. The new conservative executive<sup>3</sup> swiftly passed decree-law September 2023 on spatial and urban planning measures that ‘whenever safe and technically feasible, allow for the construction, restoration or reconstruction of buildings, uses and activities in the same conditions as those that existed on September 19th, 2021 in the area today occupied by the lava flow’ [67]. This principle was repeated in the new decree on measures for the recovery of agricultural activities [77].

With the new reconstruction strategy, both decrees seem to overlook the big changes in the area after the eruption and the possibility of a new catastrophe. Instead, they respond to the calls of those residents who demanded, right from the outset, that things be restored to how they had been prior to the eruption. More than anything else, the strategy is a long-term mission statement: authorisation is only currently given for the reconstruction of homes and the recovery of banana plantations on land where the thickness of the lava is less than 10 m, and the number of plots that fulfils this requirement only represents a small part of the surface buried under the lava (Fig. 6).

Although the strategy upholds the notion of replicating the situation prior to the eruption, it is impossible to overlook the existence of large areas where, ‘due to the presence of high temperatures, the possibility of subsidence caused by lava tubes, and/or geo-technical conditions not conducive to construction work’ [67], the restoration of the former built environment is simply not feasible in the short or mid-term. Indeed, both decrees delay the recovery process in such situations ‘until circumstances permit it’ and it is ‘safe and

<sup>3</sup> The regional government was made up of four parties: Coalición Canaria (a regionalist right-wing party), Partido Popular (a state-wide right-wing party), Agrupación Herreña Independiente (an island party for a long time associated with Coalición Canaria) and Agrupación Socialista Gomera (a splinter group from the PSOE in La Gomera that had formed part of the previous executive). Authority over the spatial planning of the lava flow was in the hands of Coalición Canaria through a newly created Regional Vice-Ministry for the Economic Recovery of La Palma, integrated into the Regional Presidential Ministry and led by Nieves Lady Barreto, the political head of Coalición Canaria in La Palma.



**Fig. 10.** Relocation and land readjustment areas in La Laguna-La Asomada  
SOURCE: Reproduction of map featured in [74].

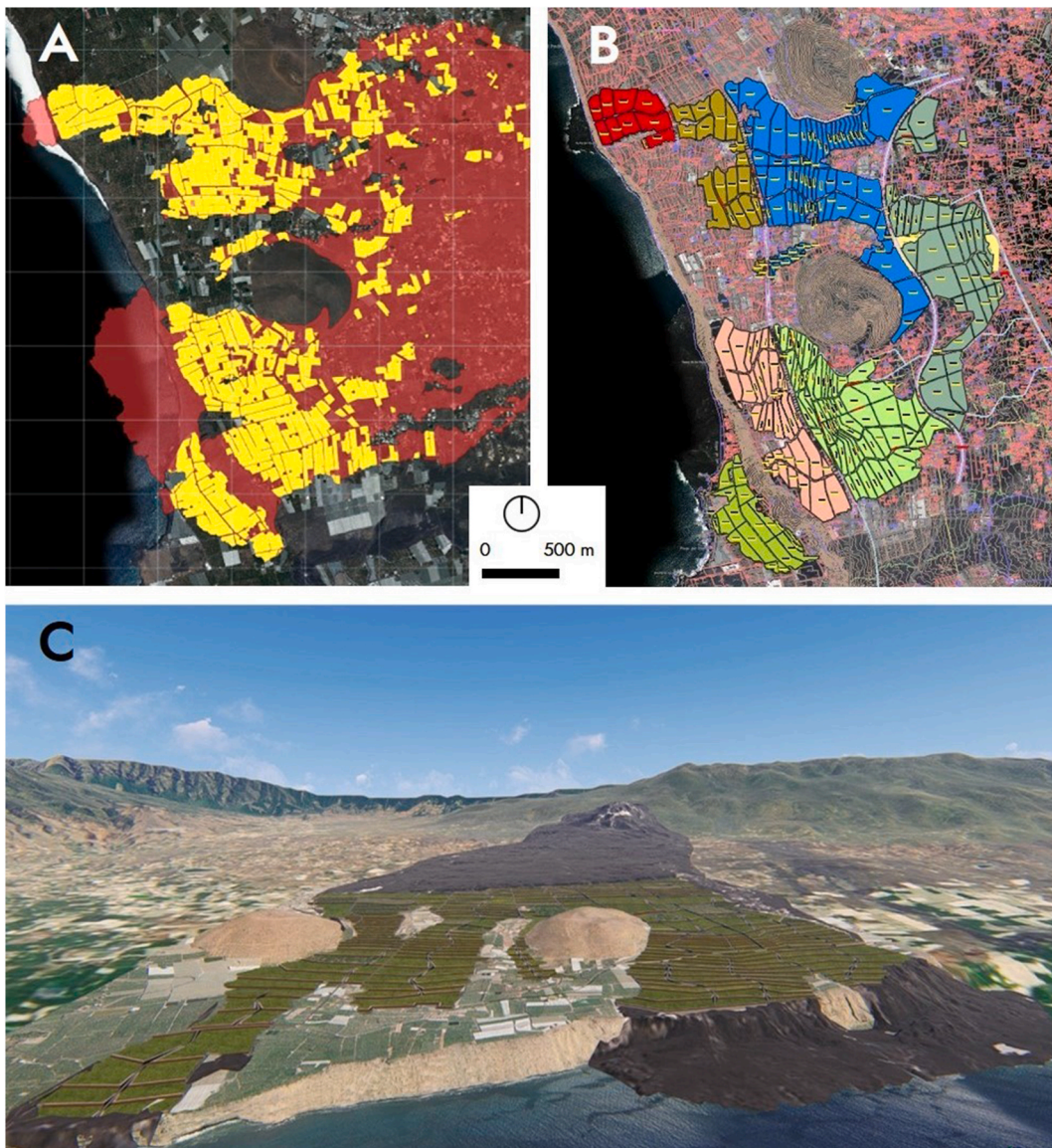
technically feasible'. That is, no forecast is made of when these places can be reoccupied or even whether this will be possible across the whole lava flow.

At the same time, it is impossible to know the exact number of plots where the thickness of the lava is less than 10 m, since the maps drawn up in technical preparation for the decrees have not been published in open re-useable formats. We know that the reconstruction of homes can begin on 251.3 ha, 19 % of the area under the lava, since it has a thickness of less than 10 m (Fig. 12), but we do not know how many affected people this will benefit.

In the case of the recovery of agricultural land, this is even harder to estimate because the Government of the Canary Islands has not provided information on the size of the plots where plantations can immediately be restored, aside from a general statement by the Regional Ministry for Agriculture indicating that, at the end of the process, 75 % of the surface area used for banana-growing prior to the eruption can be recovered [78]. Whatever the case, the map that accompanies the draft decree clearly demonstrates the difficulties involved in recovering a large part of the area earmarked for the restoration of agricultural activities, due to both the thickness of the lava and the risk of subsidence (Fig. 13). In both cases, any intervention work will be conditional on prior technical and scientific reports, highlighting the high degree of uncertainty.

An analysis of the stated purpose of both decrees is equally important. This is because, from the drafting, the predominant message they seem to convey is immediate action and interventions into the lava flow. The idea of fighting against nature is implicit in this message, since it is even stated that 'the public authorities must prevent the eruption from imposing its reality and creating an uninhabited space in Valle de Aridane' (urban planning decree) [67] or that the eruption might transform it into 'an impoverished area' (agricultural decree) [77].

This fight against nature and the underlying desire to overcome it both tie in with the mentality of part of the local population, who regard the environmental protection measures that have been taken in La Palma in recent decades as excessive. This explains why there



**Fig. 11.** Recovery of banana plantations by concentrating plots. (A): Buried banana-growing estates (yellow); (B) The organisation of plots following their concentration; (C) Recreation of the resulting landscape. SOURCE: (A) and (B): Reproduction of maps featured in [76]. (C) Reproduction of figure featured in [75].

is no political wish to extend the protected area of the lava flow –a simple, effective strategy in preventing the risk of bad spatial planning, since it would immediately reduce vulnerability in the event of future eruptions [22].

The biggest change that the decree-law introduces in relation to previous drafts is its complete failure to contemplate a global recovery strategy headed by the public administration. It prioritises a reconstruction process based on individual projects - an option clearly voiced by Pedro Afonso, Vice-Minister for Economic and Social Recovery in La Palma, when he stated that the new regional government ‘has always upheld that there should be as little public intervention as possible and that the reconstruction process should be headed by private initiatives’ [79]. As a result, development projects have been given priority over planning. This clearly jeopardises a coherent spatial model.

This pro-development neoliberal stance accounts for the abandonment of the land readjustment process envisaged in the previous government’s draft texts for both residential and agricultural recovery. Clearly, the land readjustment process would not be easy, given the pre-eruption scattered pattern of properties and the owners’ lack of consensus on the virtues of the proposal. However, the decision that was finally made only offers a solution for part of the affected population, and there are even uncertainties in their case, such as how and when the provision of basic services (electricity, water, drains, waste services, phone lines, etc.) would be tackled in certain places where reconstruction was authorised, given the high temperatures of the lava. The population not in a position to rebuild their

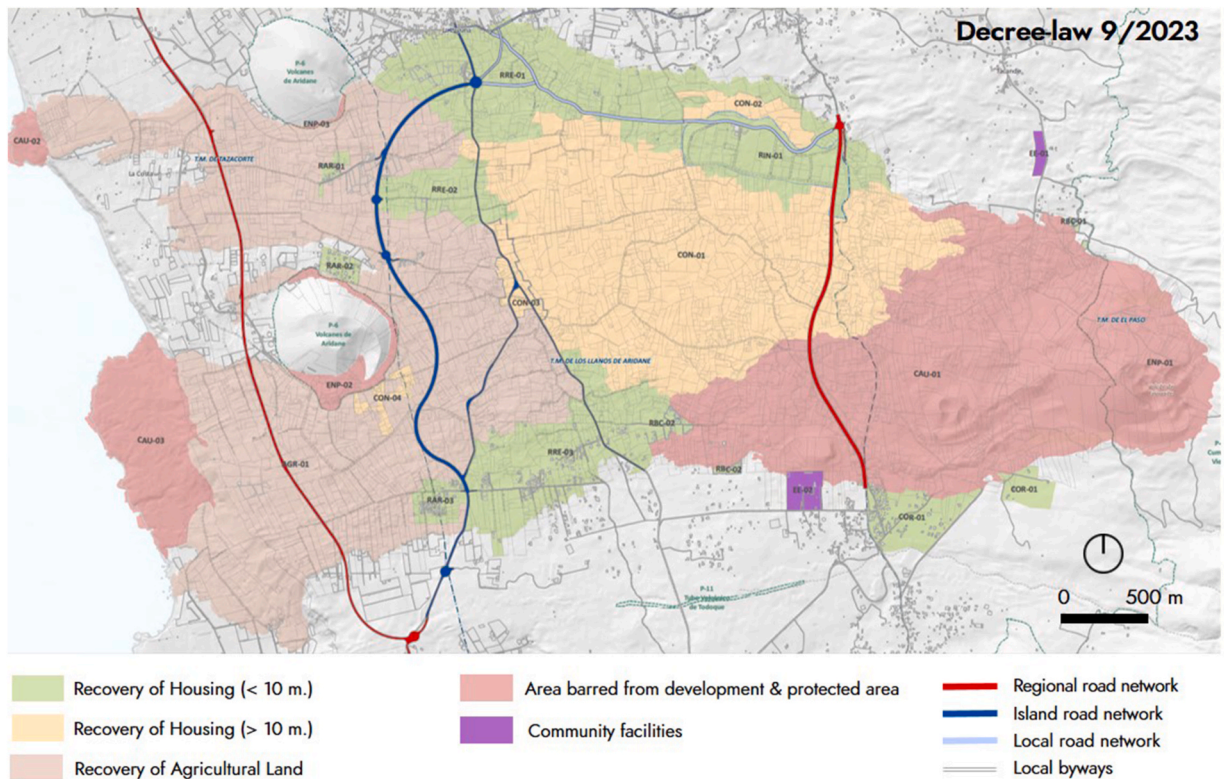


Fig. 12. Structural planning of the area of the lava flow (decree-law 9/2023).

SOURCE: Reproduction of map featured in [67].

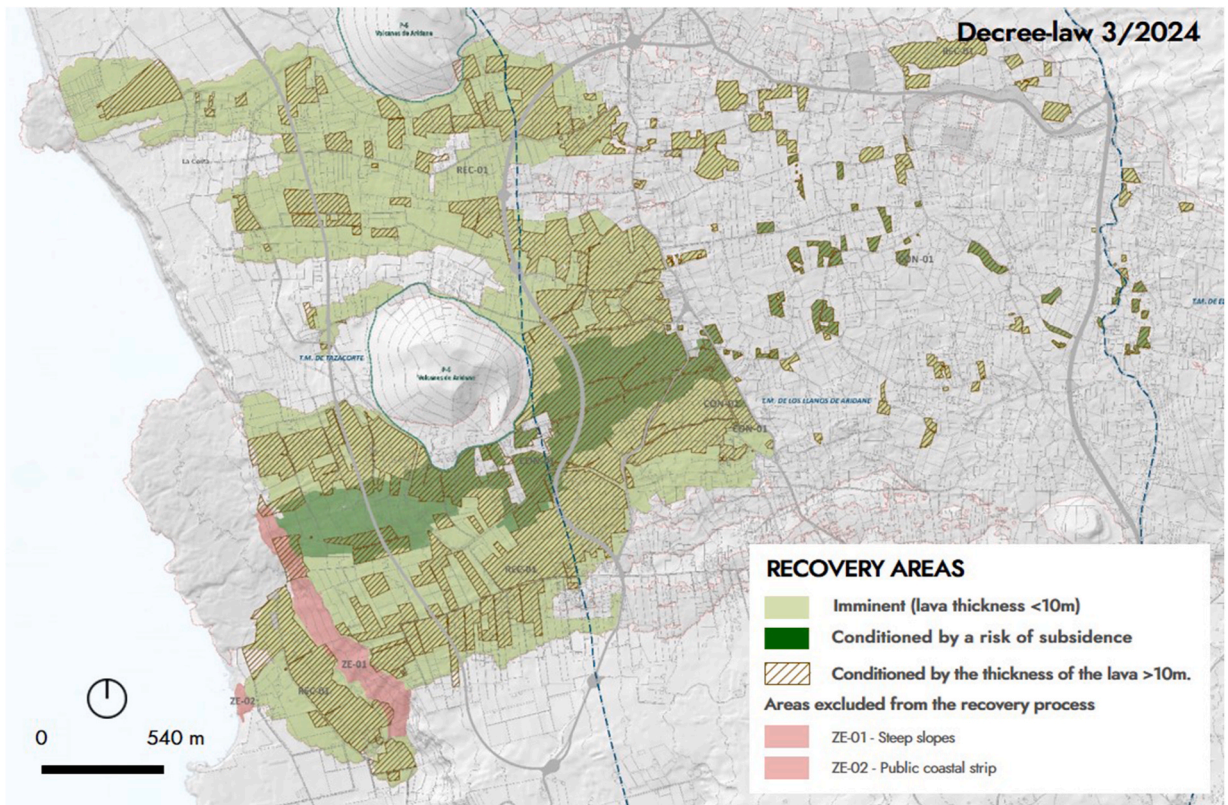
properties were left in limbo, particularly those who had lost their agricultural land. The recent decree on social housing [80] might be the only viable option for those who cannot afford to rebuild their homes, provided that the envisaged housing is actually built.

## 6. The failure of volcanic risk reduction planning: the role of the socio-political context

Some planners involved in the planning proposal for Valle de Aridane stated in a recent academic paper that each new version of the decree-law had moved further away from the more efficient spatial planning model originally proposed, 'as a result of the search for consensus between a local population that was not yet ready to accept a new model of settlement after the catastrophe and a political vision focused on the short term' [81].

This shows the relevance of the social and political context in addressing major changes in urban planning in places affected by high volcanic hazard. In any case, it should be borne in mind that any proposal was hindered by the previous approval of decree-law January 2022. This legislation was passed a few days after the eruption came to an end, in a dramatic context with regard to the housing needs of the affected population. The law allowed those who had lost their homes to build on any kind of rustic land provided that they owned a plot there. This was completely contradictory to the need to curb the scattered settlement and encourage its concentration, as would be required by appropriate risk management in post-disaster land-use planning. This legislation could also not be explained by supposed difficulties in finding suitable land for housing because, on the island as a whole, there was and continues to exist disposable land for urban development under current urban plans, where 9401 homes could be built, with 53.3 % of them in Valle de Aridane itself [63]. Giving priority to individual solutions to the housing problem, without taking into account the overall joint impact of the catastrophe for Valle de Aridane, was a bad start to the intended changes.

Even so, until the regional elections of May 2023, the different planning drafts of the framework for restoring normality in La Palma contained a certain idea of restraining dispersed settlement. However, both the location and the number of envisaged inhabitants on the land pockets proposed outside the lava flow were, in our view, some of the most controversial aspects of the versions 6 and 7 of the decree. Why earmark land for 15,400 new residents when there were only 2329 affected people, particularly in an area at high volcanic risk, with a total population of fewer than 33,000 inhabitants in 2021 that showed clear signs of a slow-down in its growth? Similarly, flooding the market with land for urbanisation at the expense of the consumption of scarce rustic land does not seem to be the best way to contribute to improving the spatial model. This proposal, promoted by the political leaders of the affected municipalities and their respective urban planners, reveals a clear interest in taking advantage of the emergency mechanisms set up in the context of the catastrophe to achieve rapid real estate development, thus avoiding public discussion, which would have been necessary in ordinary



**Fig. 13.** Territorial scope of the recovery of agricultural land (decree-law 3/2024).  
SOURCE: Reproduction of map featured in [77].

procedures. It is therefore a good example of how disaster capitalism works, curbing spatial planning and devaluing mid- and long-term collective interests.

The approval of the decree-law focused on residential recovery was delayed as a result of pressure by local people through specially created participative mechanisms and platforms of local residents who demanded the replication of the previous scattered settlement pattern on the lava flow. In fact, the eighth draft version underwent substantial amendments, including the abandonment of the urban development outside the lava flow. It is likely that some of those affected people, closely linked to Coalición Canaria (the political opposition party at the time), played a decisive role in the stance of the associations representing them, in order to destabilise the regional government, but we must not forget that this kind of attitude is common among the victims of a catastrophe. Moreover, in La Palma, the demand to rebuild upon the lava flow could be associated with a particular idiosyncrasy strongly influenced by a local 'history of overcoming, adaptation and continuous territorial resilience' in the face of a notable diversity of environmental adversities [82] which, beyond its veracity, is the dominant narrative within the public imagination of the island's society. It reveals not only a bias in part of the population's perception of volcanic risks but also a clear rejection of being relocated due to a fear of the consequences of being uprooted [33].

After the May 2023 elections, when a new government based on a coalition of state and regionalist right-wing parties came into power, led by Coalición Canaria, approaches aimed at limiting scattered patterns of properties disappeared completely. Keynesian approaches to planning were put aside in favour of neoliberal principles facilitating individual solutions. The main recovery strategy offered to victims in decree-law 9/2023, which was finally approved in January 2024, is the on-site restoration of what was previously in place. The amendments introduced by decree-law January 2022 are no less relevant, since they allow the affected parties to build second homes and tourism accommodation on land protected for scenic or agricultural purposes. This contributes to the intensification of the scattered properties that originally stood there and to an increase in speculation in rustic land (a market already under a large amount of strain due to the catastrophe) [83], further accentuating difficulties in access to housing.

The political parties currently in power promote the recovery of the pre-existing settlement, which they consider to be a symbol of local identity: 'La Palma's traditional way of life', in the words of Regional Minister Nieves Lady Barreto [84]. Minister Barreto claims that due to the island's limited surface area and the wide spatial extent of the volcanic hazard, there is no other planning alternative if that local identity is to be conserved. Furthermore, by encouraging the greatest possible occupation of the lava flows generated by the eruption of 2021, a narrative connected with the process of clearing the lava flows from the eruption of 1949 is constructed. Popularly considered to represent a genuine milestone in the economic development of Valle de Aridane, by making the expansion of banana-growing land possible, it integrates the idea in the collective imagination of 'overcoming, adaptation and territorial resilience'

[82] noted above.

This is why many farmers opposed the concentration of plots of land and, instead, wanted the lava on top of their properties to be broken up in a similar style, even claiming that after the 1949 volcano, ‘there was no need for any legal instrument’ to permit this [85]. These arguments underestimate the volcanic hazard in the spatial planning of the area, pandering instead to the wishes of some of the affected farmers. Nonetheless, the politicians behind this legislation seem to be fully aware of the implications of their proposal, in terms of the risks and vulnerability that it involves. Consequently, in their public statements, they start by asking the victims to insure any newly built homes for their real value while also demanding that the Spanish state cover all the costs of any damage caused by a future eruption. The priority, therefore, does not seem to be the reduction of risk and vulnerability through better land-use planning; instead, it is to ensure through legal provisions a high level of financial compensation for those affected in the future.

Finally, the absence of a global recovery strategy for all the victims, regardless of the thickness of the lava where their properties stood, leads to very unequal solutions depending on their financial resources. If all this is evident in the case of the residential recovery process, it is equally obvious within the banana-growing sector, as demonstrated by some farming associations, given the inability of most of them to meet the costs of the work that is needed to break up the lava [75], even with the promised financial aid. In the final instance, if smallholders are forced to sell up, this might lead to bigger concentrations of agricultural land in a few hands, a warning paradoxically given by those who objected to the land readjustment process proposed by the previous regional government. If this were to occur, it would yet again confirm that the main outcome of catastrophes caused by natural events is the deepening of socioeconomic inequalities [11].

## 7. Discussion

The management of low-probability, high-impact risks is a highly complex matter because people tend to forget the magnitude of the effects as time passes. This is what happens with some eruptions. Since they occur infrequently, they tend to be forgotten as a potential threat. In La Palma, given the extent of the disaster caused by the 2021 eruption, one might think that future risks would not be overlooked. However, given that the political authorities of the different administrations involved did not have the same criteria on the issue, it is not surprising that the consideration of risk and vulnerability had a marginal presence in the proposal that was finally adopted.

Ideological discrepancies and part of the affected population’s rejection of any solution other than ‘a return to before’, rebuilding what the lava destroyed, confirms not only the existence of large differences between the risk perceptions of planners and part of the population, but also the role of ideologies and political agendas in the stance taken by the authorities. What stands out as being particularly serious is the fact that not even the magnitude of the destruction caused by the last eruption has managed to raise a lasting awareness among local society, including the victims, of the need for careful land use, despite their knowledge of the risk. The lack of a risk culture demonstrates how hard it is to influence the structural risk factors involved in catastrophes brought about by natural events. Unfortunately, this kind of behaviour is not exclusive to La Palma: the reconstruction of the Italian city of Mascali in its original location, following severe damage as a result of the 1928 eruption of Mount Etna, demonstrates the continued social and political tendency to rebuild on the ruins of a disaster [86]. Examples of other volcanic islands unfortunately point in the same direction: volcanic risk has no influence on land-use planning, there is often no strategy for medium-term risk reduction and emergency plans are often reactive rather than proactive [39].

From a spatial planning point of view, what happened in La Palma shows the limits of citizen participation in medium- and long-term planning processes when issues like volcanic risk reduction are involved, due to the victims’ difficulty in considering the general future interests of society beyond just one generation. It could be argued that meeting the demands of the majority of the victims present at participative sessions is part of a people-oriented recovery process -one that takes into account their preferences and their desire to return to their original way of life. Nonetheless, is this the correct move to make in light of scientific evidence? This is obviously not an easy question to answer. However, it is no less true that the outcome of the citizen participation process could hardly have been different in a society that has never been aware of volcanic risk. What happened came as a surprise to the bulk of the population, who had idealised volcanoes as mere tourist resources. The responses of people who most suffered from the eruption show that they still consider what happened to be an exceptional event that will not be repeated in the short term.

The attitude of the political authorities does not help at all to bring about the necessary change of mentality in society that would facilitate a more adequate management of volcanic risk. For example, the construction of a road over the lava flow, promoted by the Cabildo Insular a few days after the end of the eruption, is a clear example of bad practice that sent the wrong message to the population. This work was started without a prior risk analysis or an assessment of the geomorphological values of the lava flow that could be preserved [87,88]. The job was also given to local contractors with no experience in the development of such a road. All this sent the message to the local population that the rapid clearing and occupation of the lava-covered space was possible for everyone concerned.

On the other hand, greater political responsibility when it came to making decisions on land-use planning that would minimise exposure to volcanic risk would have been desirable. With all the nuances, version 6 of the decree was a solution that allowed a middle way between the wishes of the local residents and a total commitment to risk minimisation. Obviously, relocating the entire population that lost their homes to plots contiguous to the built-up area of the three towns in Valle de Aridane would have been the ideal solution from both risk and sustainability perspectives, because it would have reduced dispersion and increased compactness. These plots could have been planned to favour single-family houses with orchards, in order to replicate as much as possible, the habitat destroyed by the lava flow, but in an organised way. However, the proximity of the elections and the dominance of neoliberal urban planning approaches in the new government weighed down any possibility of changing things even minimally.

The major problem is that this attitude towards the risk of a future eruption inhibits debate on its consideration in the spatial

planning of the island as a whole. It must not be forgotten that the eastern slope of Cumbre Vieja could be affected by lava flows, depending on the locations of vents [8,25,89]. Densely populated areas near the island's capital, Santa Cruz de La Palma, and essential island infrastructure like the airport could be partly buried by lava. Hence, it would be a good idea to move toward a strategy aimed at restricting or conditioning urbanisation in high-risk areas where the population, their property and goods and activities might be endangered, following, for instance, the approach taken in French risk prevention plans. Unfortunately, everything seems to indicate that in both Valle de Aridane and the whole of La Palma, people will continue to build what they want, wherever and whenever.

## 8. Conclusions

The measures that have finally been approved for the recovery of Valle de Aridane, particularly in the field of spatial planning, will not reduce the population's vulnerability or the risk of future similar events. This was the original goal of the centre-left political coalition in power in the Canary Islands until May 2023, which would have allowed only very selective residential and service-oriented uses on the lava flow, where more precedence was given to the recovery of agricultural activities and the protection of geological heritage. However, decree-law January 2022 and recent decrees passed by the new Conservative government prioritise the reoccupation of areas buried under the lava when it cools sufficiently and conditions allow for this.

By explicitly rejecting the reshaping of settlement in favour of relocation to areas of lower volcanic hazard and allowing for an even more scattered model – since homes can now be built on rustic land and land of protected scenic value, both of which were formerly excluded from development – the decisions that have been made do nothing to reduce the population's vulnerability. The window of opportunity afforded by the eruption to devise a safer scenario for people living in areas of La Palma at high volcanic risk has been lost. Instead, the underestimation of the volcanic risk in political decision-making in the Canaries has been allowed to continue.

The solution that was finally adopted is coherent with project-based planning, in line with the neoliberal approaches that are increasingly prevalent in legislation governing land use in the Canary Islands. We must not forget that the parties that currently make up the government were, in the past, the promoters of legislative changes that have led to a prevailing neoliberal vision in current legislation. This accounts for the contempt shown by the new regional government for a comprehensive planning proposal for Valle de Aridane, even though the strategy adopted is contributing to a rise in land prices and far more difficult access to housing.

In this scenario, in which much of the population and the victims share a short-term vision and a volcano is seen by some political heads as a tourist attraction that should be fully exploited, it is far-fetched to expect spatial planning measures to be adopted that take into account the island's natural hazards and strive to minimise vulnerability. Additionally, there are evident discrepancies in different agents' perceptions of the risk, and politicians have little interest in going against the wishes of certain victims, possibly for electoral reasons. All this points to serious failings in volcanic risk governance in the Canary Islands during the post-disaster phase. The clear lack of political will to make decisions that may prove unpopular in the short term with the population will continue to prevent adequate measures for the substantial improvement of volcanic risk governance from being taken.

The catastrophe that occurred in La Palma is just a small warning of what might happen on other islands with an active volcano, such as Tenerife, where the population potentially affected by an eruption could be much higher. The people of the Canary Islands must accept that living with the risk of a volcano implies the need to take certain measures that limit their freedom in relation to the use of the land. In this way, the suffering of future generations that might have to deal with the effects of an eruption similar to that of 2021 can be mitigated. Sadly, the disaster – which continues to impact the population of La Palma more than three years after the eruption's conclusion – has not served to foster a genuine risk culture, which might have led to more similar volcanic risk perceptions among different agents, thus making it easier to reach a consensus on the preventive measures to be taken in spatial planning.

## CRediT authorship contribution statement

**David Ramos-Pérez:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **José Alberto Rio Fernandes:** Writing – review & editing, Supervision, Conceptualization.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Data availability

No data was used for the research described in the article.

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