

**CIVIL DEFENSE PLANNING IN THE CANARY ISLANDS, WITH ESPECIAL
REFERENCE TO VOLCANIC ERUPTIONS**

by

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Natural hazards in the Canary Islands

The Canary Islands are of moderate extention (7,450 Km²) compared to other volcanic archipelagoes such as Hawaii (16,660 Km²) or the Azores (2,300 Km²), but are very heavily populated with 1.5 million inhabitants. Moreover, being a popular tourist resort, one can add a steady visitors load of some 300,000 people more (5.4 million a year). The heaviest population density is reached in Tenerife with 423 inhabitants per km², the lowest in Hierro, with 26.4.

Thus, there are ample reasons to attend to the natural hazards that may harm the population or personal property as well as the territory itself, which is very rich in natural values (endemic plants and animals, unique habitats, etc.)

Obviously, there are some hazards typical of continental areas such as river floods, snow storms and avalanches (v. LANE 1986) which are not present in these islands. The Canaries, however, are exposed to other hazards which are directly linked to their volcanic origin, insular condition and geographical position.

The main interest of this report is to focus on volcanic and associated risks, but I think that the other hazards deserve some short comments in order to understand the relative importance of volcanic risk.

'FLASH-FLOODS'

There are no rivers in the Canary Islands and one would not expect problems with water-flooding. This is not fully true. The "barrancos" or ravines which are normally dry in the summer or throughout several years of drought (on the lee side of the islands), may run violently when special abnormal wheather conditions occur. When a depression establishes in the Atlantic, West of the Canaries, warm moisture-laden air masses arriving from the

South-West strike the islands giving rise to heavy rainfalls in short time periods. Such storms which cause flash-floods occurred in 1957 in La Palma (500 l/m² in 48 hours), 1968 in Tenerife, 1971 in Gran Canaria (250 l/m² in 24 hours), 1977, 1979 and the last one in 1988 in Hierro with a record of 700 l/m² of rain in 24 hours.

People forget the torrential character of rainfall and that the abrupt Canarian landscape has not been molded by the soft, erosive and milenary action of tame rainwaters, but by sharp cuts, landslides, carves and overhangings caused by heavy down-pours.

During calm periods people settle in the margins and beds of the ravines. Thereafter, when the the flash-flood comes, it batters down roads, telephone poles, animal sheds or huts, or sweeps away cultivated fields which were badly placed. In some cases there has been also human loss. The worst was in 1957 in La Palma, where 32 men died or disappeared (MARZOL JAEN, 1988); and most recent, that of El Hierro last year, with 3 deads.

There is a perpetual risk of flash-floods but their consequences are to be related more to the inconscious behaviour of people and planners than to the natural factor itself. In 1988, for instance, large areas of Las Palmas were severly flooded by rainwaters; the new terrains of the city gainged to the sea, blocked the natural drainage.

'GUSTS OF SEAWATER'

The Canary Islands are placed in the Eastern Atlantic and, therefore, outside the influence of hurricanes and waterspouts that are so common in the other shores and which affect the Caribbean islands.

Nonetheless, sea-gusts have been registered in the Canaries from time to time. They normally produce limited damage in some coastal cities and villages in the North and the Northeast side of the islands, flooding the first rows of houses and partially destroying fishermen's harbours and facilities. The reoccurrence of these localized sea-gusts during heavy storms, in the same places, must be related to the shape of the coast.

* Again, the consequences of sea-gusts are restricted normally to civil work, and are mainly related to poor civil engineering and people's unconcern when constructing too close to the sea. However, in the last sea hit in Garachico (January 1987) two men were swept by the waves: a tourist and a rescue volunteer.

BIG FOREST FIRES

Forest fires are unfortunately a common event in the Western Canary Islands, which are more humid and vegetated. Most of the fires originate by accident or are intentionally set (22% in 1988); very few by natural phenomena (lightnings, etc). The great majority are extinguished just after they start, or controlled some hours later. Nonetheless, despite the great prevention and extinction equipment employed each summer in the islands, there are circumstances of fuel accumulation, dryness and mainly wind, that drive the forest fires out of control thereby extending over great distance and lasting several days. Such big fires happened in La Palma in 1975, again in 1988, in Tenerife in 1983 and in La Gomera in 1984. This latter one was very tragic: 20 persons perished, one of them being the Civil Governor who was guiding the extinction forces. Regarding human loss, that has been the second greatest natural catastrophe in Spain in recent years.

Forest fires receive the greatest attention and resources of Canarian authorities. Fire prevention and extinction plans are updated and implemented on a yearly base. The last one (INYPISA, 1989) includes a sophisticated computer program which can simulate the fire's behaviour in specific circumstances and localities.

LOCUST SWARMS

The island of Fuerteventura is only 110 km away from the African shoreline, and La Palma, the farthest one, 520 km. Thus, the Archipelago cannot escape from a natural calamity that sweeps the neighbouring Continent: the locust plague.

Locust populations drastically explode in Africa in relation with abnormal climatic conditions, particularly rainfall in the Sahel. The huge swarms generate and spread through Africa, some of the them to the North-west, and some may be deviate to the sea and reach the Islands.

Several massive invasions of locust have been registered in the Islands since 1587, but only five in this century: 1908, 1910, 1932, 1954 and 1958. At present, there are many countries involved in the monitoring and control programs of locustids in Africa, Spain belonging to that group.

The Canarian "Regional Commission for the Monitoring of the African Locust" declared a state of alert last year, but fortunately the islands were not hit by the main swarms; only a few hundreds of specimens arrived. The positive side of this natural hazard is that it can be foreseen with enough time, and the existing defense plans are consequently updated.

EARTHQUAKES

It is not always easy to distinguish tectonic earthquakes from seismicity related to volcanic activity, which is constant in these islands. Some authors (i.e. J.C. CARRACEDO, pers. com.) consider that all earthquakes in this area are of volcano-tectonic origin.

The Canaries are placed in the African margin of the Atlantic, which is considered as tectonically not very active ("passive borders", v. ORTIZ & ARANA, 1986). Therefore, earthquakes related to adjustments of the plate (liberating accumulated energy) are -if any- not frequent, unpredictable¹ and located apparently in the corridors between the islands (T. BRAVO, pers. com.)

Such an earthquake happened this year at night, the 9th of May. Its intensity was 5.2 on the Richter scale but the impact on the population in Tenerife was magnified because people immediately thought that a volcano was "about to burst"; and people fear volcanoes. The last replica of that earthquake was the 31 of August, three months later².

VOLCANIC ERUPTIONS

In the short period of 500 years of Canarian history, there have been 16 volcanic eruptions, and at present, one volcano -the Teide Peak- is still active (gas emanation).

There exists much information related to historic Canarian volcanism (HERNANDEZ PACHECO, 1984) and several authors have studied in depth the risk of volcanic eruptions (ALONSO 1986, ARANA 1984 and 1986, BOOTH 1979, CARRACEDO 1984, 1987 and 1988, MEZCUA 1984, ORTIZ 1986, TOMBLIN 1986, VIERA 1984, etc). It is not my intention to repeat here what they have already exposed and discussed, but it is worthwhile to outline some major points.

The probability of new volcanic events is higher in those islands which have had eruptions in historical times:

La Palma > Tenerife > Lanzarote

¹Perhaps not all hope is lost. See "Abnormal animal behaviour prior to earthquakes, I", 1976 Munlo Park, California: Office of Earthquake studies, US geological Survey (taken from LANE, 1986)

²Interview to C. QUINTERO, "El terremoto de Canarias puede aportar novedades sobre la formación de las islas", Diario de Las Palmas, 24 Oct. 1989.

Eruptive intervals vary between 1 and 237 years with a mean value of 30 years and a standard deviation of 25 years (CARRACEDO, 1988). Very little can be said about the future, but I would be a happy naturalist if I could see another eruption in my lifetime.

In any case, volcanic risk relates not only to eruption probability, but to the foreseen effects on the populations and human installations. Thus, the increasing economic development of the islands and the concentrations of population in some areas increase the risk considerably.

Tenerife > La Palma > Lanzarote

The damage of past volcanic eruptions has been limited if we exclude that of Montaña Negra in Tenerife (1706), which buried half of the harbour of Garachico, and the very long eruptions of Timanfaya in Lanzarote, which covered large extensions of cultivated fields and forced people to move. The other historic volcanoes -all of efusive type- have been harmless except for one death during the eruption of Teneguía in La Palma (1971): A fisherman went too near to the lava flow and was killed by suffocation.

This latter eruption happened when I was a graduate student. I visited Teneguía with my Professor in Geology, Dr. Bravo, and I still remember the event as an "academic eruption".

These types of "soft" eruptions with low energy are the most probable to repeat (80 -90%) in the Canaries, particularly in the Southern middle ridge of La Palma and in Tenerife (also in its central mountain ridge). Explosivity is low and the lava flows dense and slow, allowing time to react and evacuate people down-slope. The areas where centres of emissions are likely to occur, are mostly uninhabited but, on the contrary, heavily forested, causing risk of forest fire.

Other damage may include interruptions of road usage, phone communication, energy and water supply and the direct but limited coverage of fields and properties by ash (few km away), or by the lava itself. In islands the possibility of isolation is much greater than in open continental areas; however, there is always a chance to evacuate people by the sea.

"Moderate" eruptions of intermediate energy like those of Teide-Pico Viejo complex, are less probable to occur (10-20%). The last one was that of Montaña Blanca -attached to Teide- which has been dated in the year 510 b.C. (SOLER, in ALONSO 1986). They are less probable indeed, but with much more risk. Explosivity is higher with an abundant emission of piroclasts, lateral explosions of high temperature, possible ashflows and 'glowing clouds' and perhaps abundant gas emanations.

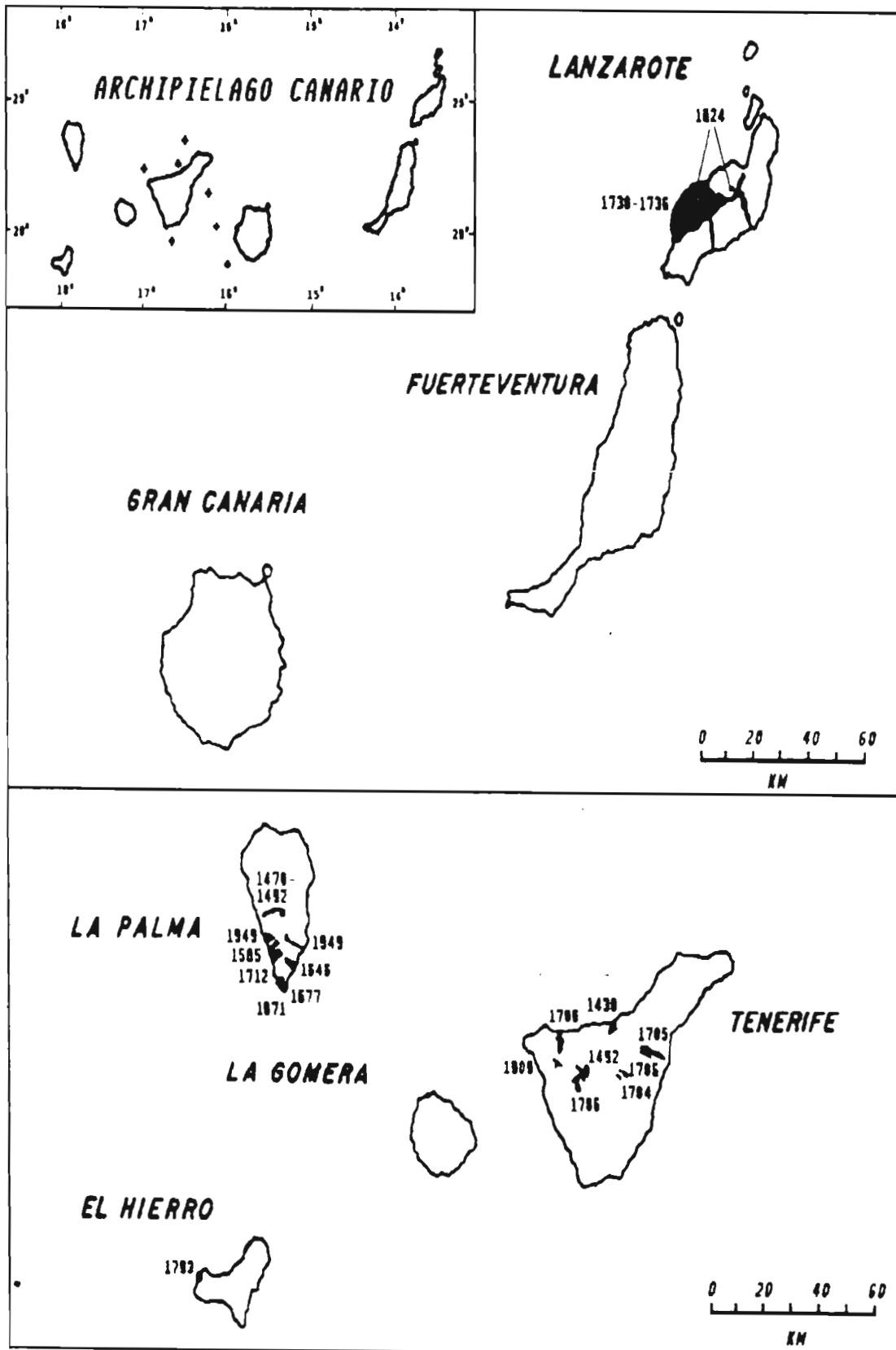


Fig. 1. Historic volcanic eruptions in the Canary Islands (circles = earthquakes outside the Islands)

The destruction associated with this type of eruptions depends primarily on the location of the centre of emission, the weather conditions and local topography (for instance, formation of mud flows by liquation of snow in Teide). Wind plays a very important role in the distribution of ash and gas. Fortunately, there are few basins (i.e. Las Cañadas) in the islands where gas can accumulate and cause problems. Almost all island valleys are open to the sea and absolute wind calms are generally very rare.

"Hard" eruptions of really high energy are not expected to occur in the Canaries, at least in the present geological phase. However, there are situations in which "soft" or "moderate" eruptions reach higher explosivity due to water entering in the ascension paths of lava. There have been phreatomagmatic eruptions in the Canaries (not in historical periods) and signs of the violent surges that originated have been identified. Much depends on casualty and one cannot disregard fully that risk.

Volcanic seismicity is very active during the eruptions and sometimes before, but its intensity is normally moderate, and in principle, lower than that of eu-tectonic earthquakes. The major problems associated with seismicity is the psychologic effect on the population which tend to magnify real threats and fall into mass catastrophism.

For further and detailed information regarding volcanic risk (danger maps, lava behaviour, expected damage, needed instruments, etc) I recommend consulting the referred bibliography.

Civil Defense in Spain

Civil Defense³ in Spain is conceived as the physical protection of people and their goods in situations of grave colective risk, public calamity or extraordinary catastrophes. This definition includes situations such as war, big "chemical accidents", large city fires, and of course, natural calamities.

The centralized and quasi-military system of Civil Defense, that was traditional in Spain, changed with the Constitution of 1978. Under its provisions, the newly established Autonomous Communities -like the Canary Islands- may assume the "vigilance and protection of buildings and facilities, as well as the coordination and other rights in relation to the local police" (art. 148.1.22).

³When using the term "Civil Defense" in this paper I am referring to the Spanish "Protección Civil" in its strict sense. In Spain the concept of "Defensa Civil" is a broader one (v. DE LA OLIVA, 1986).

In this context, a new State Law of Civil Defense became effective in 1985⁴ cancelling the old regulations of 1941 and 1976. Several articles deal with the competencies of the Autonomous Governments (art. 10, 11, 13, 15, 17, 18 and FD).

CENTRAL ADMINISTRATION	AUTONOMOUS ADMINISTRATION	LOCAL ADMINISTRATION
Delegate of the Central Government + 2 Governors (provincial range)	President of the Canarian Government + 11 Departments Health, Energy, etc (regional range)	7 Presidents of Island Cabildos ----- 87 Mayors (munincipality)

Fig. 2. Administrations which are involved in Civil Defense

The new legislation⁵ complicates a little the original unitary system, but seeks a better adaptation to the peculiarities of each Region. The role of Local Authorities is maintained basically as before, but it segregates some of the main civil defense tasks between the Central and the Autonomous Government.

General coordination, telecommunication, military collaboration and state police forces are kept under control of the Central Government, but planning, inventories of resources, integration of civil defense plans, damage evaluation and penalties are transferred to the Autonomous Government.

The Central Government through its Regional Delegate is still the higher authority to manage and coordinate Civil Defense under grave risk or important emergencies. However, in special cases of urgency, this role can be transferred to the President of the Autonomous Government (art. 15). In any case, the necessary uniqueness of command is guaranteed.

Civil Defense is basically a matter of study and prevention of crisis, but also of coordination and management of existing resources when a crisis takes place. Rescue operations, evacuations, accomodations, sanitary and social assistance and the

⁴«Ley 2/1985 de 21 de Enero sobre Protección Civil.»

⁵ Included also the Royal Decree 1378/1985 of provitional measures to act in situations of emergency in circumstances of grave risk, catastrophe or public calamity.

restoration of essential public services are also duties of Civil Defense. As inferred, it is not necessary to create ex novo special services for Civil Defense just to organize and coordinate existing ones. These services belonging to three different administrations, imply some added difficulties, but can be overcome through good planning.

Civil Defense Plans are of two types: (a) Territorial and (b) Special. The former type is scaled from Regional Plans to Municipal Plans. They deal with overall organization and coordination in their respective administrative territory. The Regional Plans are approved by the Autonomous Government and homologated by the National Commission of Civil Defense. The other plans are homologated by the Canarian Commission on Civil Defense.

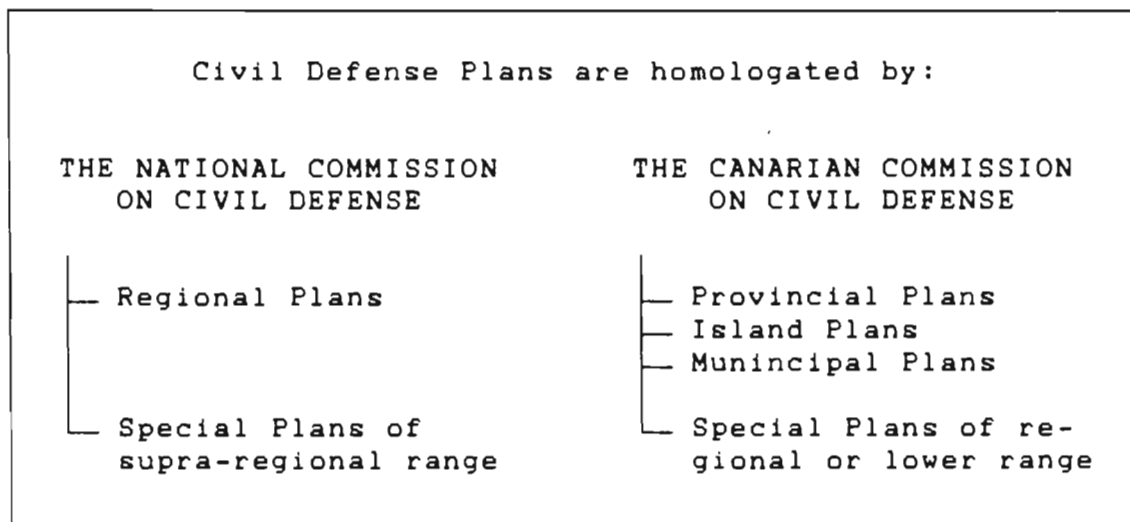


Fig. 3.

The Special Plans relate to specific activities or types of emergencies (forest fires, volcanic crisis, etc) and not to a defined territorial area. However, their preparation, approval and homologation depends of the territorial range on the emergency considered.

Presently, a Special Plan for Volcanic Crisis is restricted in Spain solely to the Canary Islands and could be combined with a Regional Plan. Special Plans for specific islands would be also a valid concept because eruptions afflict only one island at a time, but this latter approach would generate unnecessary repetitions.

Civil Defense Planning in the Canary Islands

In some Autonomous Regions like Catalonia, the Basque Country or Valencia where emergencies are frequent (mainly floods), Civil Defense has been traditionally well organized and the Regional Government has assumed most of the duties without much stress.

The situation in the Canary Islands is very different. We have volcanoes, for instance, but they historically not been a major problem, thus far, Civil Defense has been poorly developed.

Shortly after the promulgation of the new Civil Defense Law, the Canarian Government legally^e assumed their responsibilities. The Canarian Commission for Civil Defense was established and the transferred responsibilities were placed in the Canarian Department of the Presidency; a good scheme in principle. But unlike other transferred responsibilities, in this case no facilities, civil servants or financial resources were attached. A minimum of specialized staff is needed to organize and elaborate the plans, keep a 'hot line' open, etc. Thus, very little has happened. The Canarian Commission of Civil Defense, for instance, has never met.

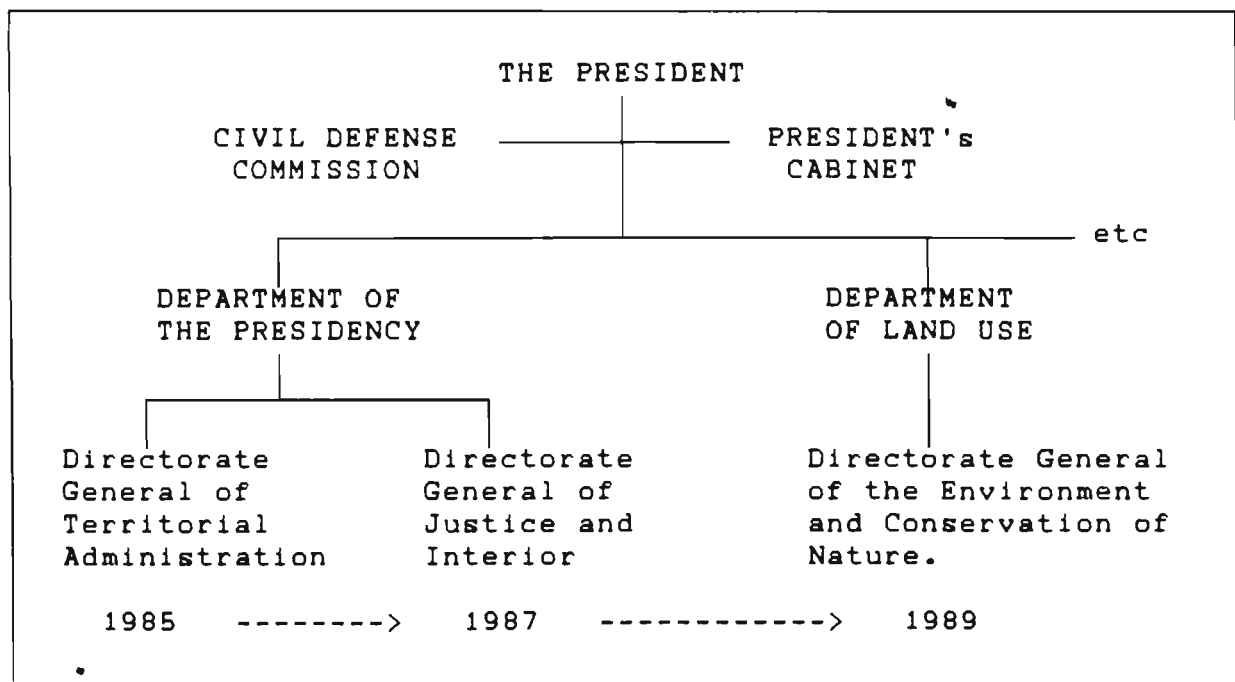


Fig. 4. Internal transfer of Civil Defense responsibilities within the Canarian Autonomous Administration.

^eIn November 1985, by R.D. 468/1985).

Four years later, the Canary Government changed Civil Defense responsibilities from the Department of the Presidency to the Directorate General for Environment and Nature Conservation, belonging to another Department, that of Territorial Land Use. Why?

The latter Directorate is responsible for the prevention of forest fires and is the only one well equipped with emergency resources: trucks, manpower, radio network (285 units), etc. As already discussed earlier, big forest fires are the more frequent natural hazards and a permanent risk in the islands, but obviously, is not the only present one to be considered. Moreover, coordination is always better achieved from top level hierarchical positions than from lower ones.

To the present time nobody has prepared a Territorial Civil Defense Plan for the Islands according to the new Law. The existing plans to fight locust swarms (DGPAC, 1988) or prevent forest fires (INYPSA, 1989), mentioned before, are a kind of "special plans", but come from the sectorial administrations (agriculture, environment, etc) and are not well coordinated with Civil Defense.

It is legally stated that in Autonomous Regions having more than one Province (two in the Canaries) the direction and coordination of actions in grave emergencies⁷ is done by the Delegate of the Central Government, who lives obviously in one of the Islands (he is Governor of that Province at the same time). This is perhaps not very wise in an archipelagic Region, but there is the possibility of naming other persons in charge (art. 5c). However, none of these important aspects have been clarified. A Regional Civil Defense Plan for the Canary Islands is highly needed.

Only recently -and perhaps stimulated by the earthquake of last May- the Civil Governor of the Province of Santa Cruz de Tenerife has prepared a first draft for a Civil Defense Plan. It is a hybrid of a territorial plan with provincial range, but especially oriented towards volcanic crisis (special plan).

This document is still in its initial phases but anticipates an operative structure with 7 acting groups (air survey, rescue, sanitary, lodging, communications, etc), the way they must coordinate and respond to the Civil Authority, and a very important item, a first inventory of resources, addresses, etc. One of the elements considered is the existence of a Scientific Committee which should play an important role in volcanic and seismic crisis, but I will comment upon that later.

⁷The law establishes that when an emergency does not exceed the territory of a municipality, then its Mayor remains responsible for Civil Defense.

Towards a coherent planning scheme

I doubt if the latter approach is the most appropriate for the Canary Islands, but at least it offers an operative way to work within one Province. However, it should be considered as a provisional stage, and efforts should be made to provide the whole Region with a coherent and planned scheme for Civil Defense.

Such a scheme related to natural hazards could be, for instance, similar to the following:

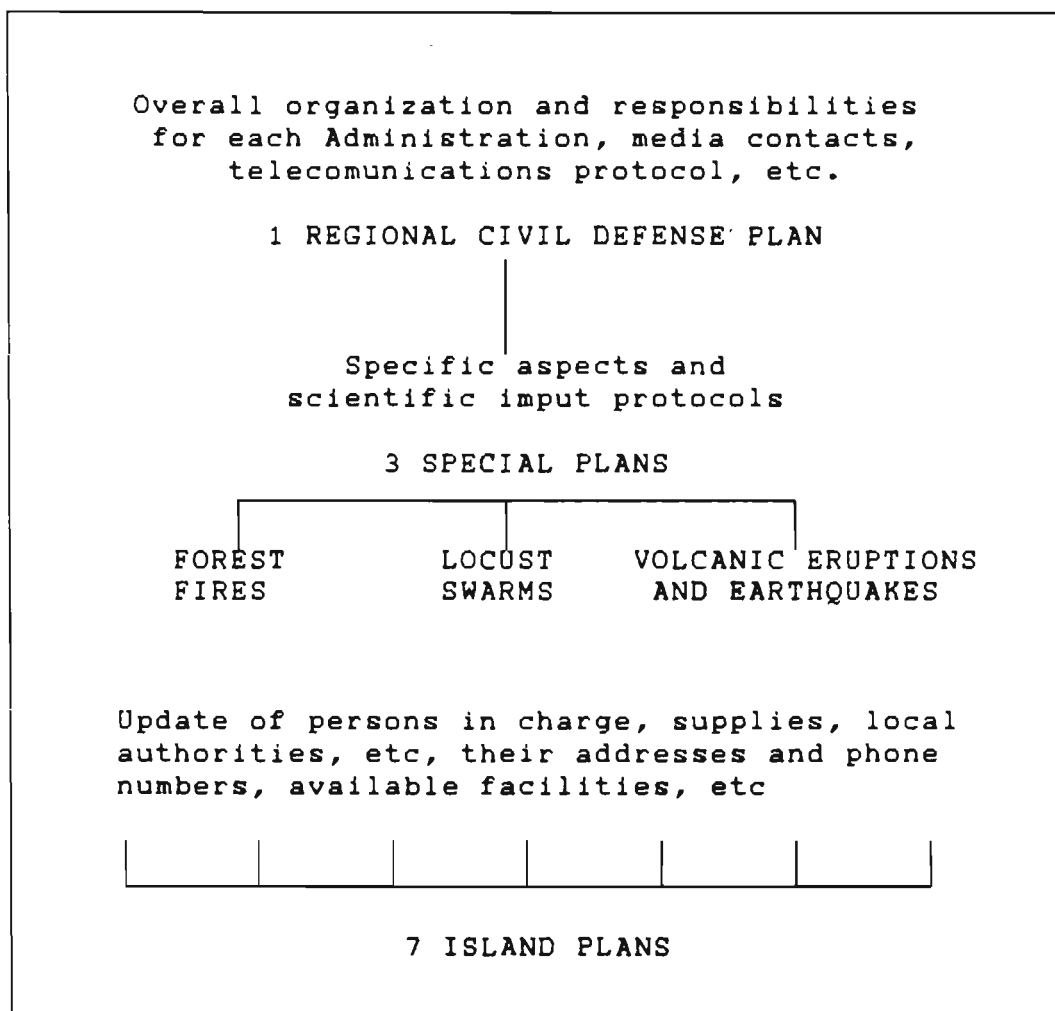


Fig. 5.

The Canarian Autonomy has a short history and its new Administration is still in a consolidation process and thus under the pressure of daily stress. Therefore, it is preferable that the bulk of planning, organizing, inventorying and updating be taken

by the Central Government, in particular, by the staff of the Civil Governors which is much alleviated from responsibilities in the present circumstances. Perhaps in the future with a more developed scheme of Autonomous Administration, a major or full role of the Canarian Government in Civil Defense could be contemplated. In that case, it should be placed at a higher position, for instance, at the President's Cabinet (see figure 4).

The overall Regional Plan for Civil Defense should be prepared by a task group integrating both Administrations and related to the Canarian Civil Defense Commission. Once the global scheme of responsibilities and common procedures is established, it will be easy to develop or revise the needed Special Plans. The Defense Plan against the African Locust and that of Forest Fires Protection* will then be easy to link to the Regional Civil Defense Plan. This is a task for the respective Canarian departments responsible for these matters.

Rationally speaking, the Emergency Plan for Volcanic or Seismic Crisis should be tackled at this level, once the overall organization of Civil Defense is settled. If the common procedures are known, its major content will be the scientific protocol for early detection, monitoring and assessment. There are no specific administrative departments related to volcanism. Therefore, this Plan has to rely much more on Civil Defense organization than any other Special Plan.

One often neglected but important peculiarity of new volcanoes, is that once in smooth eruption and seemingly harmless, they attract people and tourist in mass, giving rise to extra problems and perhaps creating new situations of risk. Volcanic eruptions are natural hazards, but also a fantastic spectacle of Nature. Good planners have to think of such risky crowds.

Finally, it is advisable to formulate territorial Civil Defense Plans for each island, because it is not easy to move resources from one island to the other. These local Plans are easier to update on a regular base, leaving the Special and Regional Plans as a more stable scheme. The Provincial Governors with the help of their Island Delegates should be responsible for keeping these plans updated.

The role of scientific input

A large bibliography and much controversy exists regarding the convenience of undertaking detailed studies of volcanoes in order to understand their behaviour and predict possible eruptions.

*This plan is prepared in accordance with the Law of Forest Fires (Ley 81/1968) and is very detailed.

"Only painstaking research and constant observation over a period of at least 10 years can reveal the 'habits' of a particular volcano and make it possible to predict when it will erupt" (RITMANN, 1971).

In our case, predicting is nonsense (v. FUSTER, 1984), but volcanic eruptions may be easily detected in advance (sometimes not) and that is of great help, obviously. It is also clear that scientific advice, during eruptive crisis or when planning for such, is crucial. These are good reasons for monitoring volcanic areas but to what extent? As usual, the answer is a matter of common sense.

In areas where eruptions are frequent and volcanic risk is very high, like in Hawaii or in Italy (v. ROSI & al. 1981), one should concentrate all kinds of efforts and specific resources (real time follow up of microseismicity, permanent gas measurements, deformations, etc). In other areas, with less frequent and intensive activity, like in the Canary Islands⁹, it is not justified to provide so many resources or install a complicated infrastructure. However, a basal monitoring has to be guaranteed, as well as the appropriate scientific input in case of crisis.

Specialized scientists will obviously be available to face an eruptive crisis if they exist; therefore, research in volcanology, seismology, etc has to be permanent. This does not mean that Civil Defense should provide all the resources for research so that the needed scientists can survive; that is a task of Research Institutions (v. BARBERI, 1988). However, some connections (i.e. targeted funds) should exist between Civil Defense Authorities and the ongoing research programs.

Fortunately, it seems to be the right moment in the Canary Islands. There are several groups of scientists and institutions involved and interested in Canarian volcanism (v. ARANA, 1986). In the last meeting of the European Science Foundation's Volcanological Project¹⁰ held in the Azores (June 1989), the Teide complex was included in the list of six "laboratory volcanoes". Also this Meeting on Canarian Volcanism reflects that interest and is a unique opportunity to discuss and contribute with suggestions from participants and expert groups.

The official seismographic network in the Canary Islands (GARCIA COGOLLOR, 1985) will be completed this year¹¹ and a real

⁹ The world list of some 200 volcanoes considered by experts as "highly dangerous" does not include Canarian ones (see ARANA 1984).

¹⁰ European Volcanological Project (EVOP). ESF Volcanology Network Research Programme, Preliminary version, 1.8.89, 15 pp..

¹¹ The seismographs of La Palma have been connected by telephone and that of Fuerteventura is about to be operative. Two new stations have been placed in Lanzarote and another in Tenerife,

time microseism station (C.S.I.C.) is operative in the base of Teide, connected via telemetry with La Laguna (GARCIA-FERNANDEZ & AL. 1988) and perhaps another station may be placed in La Palma.

A specific "National Research Plan for the Prevention of Volcanic and Seismic Crisis in the Canary Islands" has been developed within the framework of the National Plan for Scientific Research and Technological Development (Central Government). When approved, it will guarantee a steady input of resources for volcanology, and a greatly needed convergency of present research efforts.

Likewise, there exists the possibility (V. Araña, pers. com., Oct. 1989) that either a sort of "acting group for volcanology" is formally established¹² within the Spanish Council for Scientific Research (C.S.I.C.), or that a Centre for Volcanology is consolidated in the Canary Islands, also as a branch from that same institution. Either or both solutions combined are very valuable for Civil Defense because they would allow unified and direct scientific input to the emergency protocols. Such a group and/or centre would need to concentrate the efforts of other surveillance institutions and arrange the necessary agreements for a fluent data flow. Its success will highly depend on that.

Cooperation agreements would involve, at present:

- National Council for Scientific Research (C.S.I.C.)¹³
- Regional Centre of Geodesy (National Institute for Geography)
- Geological and Mining Institute of Spain (I.G.M.E.)
- University of La Laguna
- The Volcanoes House (Cabildo of Lanzarote)

Of the possible members of that group (volcanologists, seismologists, etc) the majority are based in Madrid, and that may continue so because of the better research facilities existing there. However, it would be necessary to have a permanent and physical presence in the Canary Islands. The idea of having an official Centre (Observatory...) for Volcanology or a branch of it, probably in Tenerife, is very attractive and would surely facilitate financial support from the Canarian Government. Some years ago there was a modest initiative in this direction between the C.S.I.C. and the Cabildo of Tenerife with the so-called «Estación Volcanológica de Canarias», but it never consolidated.

in Las Cañadas (National Institute for Geography, 24 Oct. 1989 DA).

¹²Similarly to the National Group for Volcanology existing in Italy since 1973 (v. BARBERI, 1984).

¹³The C.S.I.C. has several research institutions in the Canaries which are being reorganized in the present; one of them, the Institute for Natural Resources and Agrobiology has a unit equipped for volcanic research.

A draft protocol for scientific support during volcanic crisis has been written for the Canary Islands by ARAÑA & ORTIZ (1989). It is an important initiative but I do not want to expand on it because these protocols are all basically very similar and the present one is still not officially approved nor included in Civil Defense Plans.

Scientist and media

Before finishing this communication, I would like to stress the importance of the news media during emergencies. The magnitude of the problems for civil defense is directly related to people's alarm. To keep cool before, during and after an event is crucial.

People are frightened easily by natural phenomena like earthquakes and eruptions, but worry increases up considerably due to ignorance and street rumors. Therefore, mass media play a very important role during emergencies and Civil Defense Plans should be heavily based on their collaboration.

It is of utmost importance to periodically give official notes from the onset of the crisis, even if they have no conclusive information. Scientific committees or advisory groups tend to be very cautious before giving any statement; they normally need more data and some discussion, but they forget that there are people very anxious to know what is happening or may happen. It is not an easy task, and alarm increases by contradictory information as well as by lack of official information.

In the latter case, aggressive media try to contact scientist that they know personally to fill the informative gap and they may start speculating about the phenomena and future possibilities, giving rise to major confusion and/or alarm. It is preferable that they address the existence of a Scientific Committee of Civil Defense, and that they limit themselves to giving some basic instructions of how to behave meanwhile. It is a matter of ethics.

Earthquakes and volcanic eruptions are not so frequent in the Canary Islands so as to justify regular preventive campaigns. It would be self-defeating. Perhaps a better way to make people aware of these possible phenomena without generating unneeded worry, would be via the phone directory; I saw it in the Azores. Short and sensible, descriptive instructions could be inserted in the inside-covers, the front one for earthquakes, and the back for volcanic eruptions.

Conclusions

Natural hazards to be considered in the Canary Islands are in order of importance: big forest fires, flash-floods, 'gusts of seawater', locust swarms and earthquakes and volcanic crisis.

Civil Defense organization is not sufficiently consolidated in the Canary Islands, probably due to recent legislative and administrative changes (shared competencies between Central and Autonomous Government) and the infrequency of relevant crisis.

It is necessary to convene the Civil Defense Commission for the Canary Islands and to promote the preparation of a Regional Plan for Civil Defense. The existing Forest Fire Protection Plan and Locust Defense Plan should be revised and linked to it.

A Plan for Emergencies of Eruptive or Seismic Crisis should be developed in full as a Special Civil Defense Plan. A detailed protocol for the Scientific Commission should be included in it and relations with the news media are considered of utmost importance. Alarm increases by contradictory information as well as by lack of official information.

The possibility of visitors or tourists crowding to watch 'harmless' eruptions should not be overlooked by Defense Plans, because they may create extra problems and risks.

It is crucial that a minimum group of scientist is actively working on the different aspects of volcanism and equipment updated, so that they are available in case of emergencies.

The consolidation of an official research unit and/or centre for volcanology with permanent presence in the Islands is considered very valuable for civil defense protocols.

General Research Programs and Institutions should appraise, as a social need, the aspects of volcanism related to eruptive crisis and civil defense.

Until Special Defense Plans are full operative, it is advisable to call peoples attention in the islands to the possible occurrence of eruptive or seismic crisis, but without generating unneeded alarm. The inside-covers of the telephone directory are considered a good place to insert some basic instructions.

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A B S T R A C T

**CIVIL DEFENSE PLANNING IN THE CANARY ISLANDS, WITH SPECIAL
REFERENCE TO VOLCANIC ERUPTIONS**

by

Antonio Machado-Carrillo

Natural hazards to be considered in the Canary Islands are in order of importance: big forest fires, 'flash-floods', gusts of seawater', locust swarms and earthquakes and volcanic crisis. A short discussion of each of them is undertaken in order to gain an idea of the relative importance of volcanic eruptions as an emergency.

In accordance with the revised literature, emphasis is given to the low probability of having eruptions in the near future. However, volcanic risk is higher in some islands (Tenerife, La Palma and Lanzarote) than in others, but in any case, eruptions expected to occur are of effusive type (80-90%), with low explosivity.

Civil Defense organization in Spain and in the Canary Islands is shortly commented. In the latter Region it is not sufficiently consolidated probably due to recent legislative and administrative changes (shared competencies between Central and Autonomous Government) and the low frequency of relevant crisis. A scheme for a coherent planning sequence is proposed.

It is necessary to convene the Civil Defense Commission for the Canary Islands and to promote the preparation of a Regional Plan for Civil Defense. The existing Forest Fire Protection Plan and Locust Defense Plan should be revised and linked to it.

A Plan for Emergencies of Eruptive or Seismic Crisis should be developed in full as a Special Civil Defense Plan. A detailed protocol for the Scientific Commission in it and how to relate with the media are considered of utmost importance. Alarm increases by contradictory information as well as by lack of official information.

The possibility of visitors or tourists crowding to watch 'harmless' eruptions should not be overlooked by Defense Plans, because they may create extra problems and risks.

On the other hand, it is crucial that a minimum group of scientists actively working on the different aspects of volcanism is maintained and equipment updated, so that they are available in case of emergencies. The consolidation of an official research unit and/or centre for volcanology with permanent presence in the Islands is discussed and considered as very valuable for Civil Defense protocols.

Until Special Defense Plans are fully operative, it is suggested to call peoples attention in the islands to the possible occurrence of eruptive or seismic crisis, but without generating unneeded alarm. The inside-covers of the telephone directory are considered a good place to insert some basic instructions.

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