

FLOOD RISK IN TIMES OF COVID-19, PEÑÓN DE LOS BAÑOS, VENUSTIANO CARRANZA, MEXICO CITY, MEXICO

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ABSTRACT

The borough of Venustiano Carranza has an area of 33.42 km² (8,258 acres), which is 2.24% of the total area of Mexico City. It is in the Trans-Mexican Volcanic Belt, in a land of 3,341 ha (8255.79 acres) where there are mainly lake deposits. To the north of the borough, there stands a structure of 2,290 m.a.s.l. which pertains to what is referred to as Peñón de los Baños. Since the COVID-19 pandemic got to Mexico in 2020, there was a general change throughout the country in the population behaviour regarding their daily life. However, an analysis should be made on how risk is understood in times of COVID-19 in towns where risk-related problems normally occur. For the perception analysis, the town Peñón de los Baños was used a sample. In this town, floods are recurring during the rainy season, and it is one of the towns that was most affected by the pandemic during the first wave (April and May 2020), as more than 100 individuals died in just 2 months. The purpose of this analysis is to know how the population perceives the flood risk and behaves in an emergency phase, in the midst of a pandemic that entails sanitary and social restrictions, i.e., how is the population facing both problems: material losses and fear of getting infected. Both problems put people's lives at risk, but the results show the priorities and the response process in the emergency phase that is currently implemented by the population.

Keywords: COVID-19, floods, prevention actions, risk.

1 INTRODUCTION

During 2020, studies on COVID-19 were started across the globe, but focus was made on prevention and treatment of pandemic, e.g., Qu [1] and Hidalgo [2]. As pandemics evolved, contributions and research increased, but focus was mainly on healthcare and education, and no in-depth research on risks and COVID-19 has been conducted. Considering that people worldwide have changed their daily lives and have been trying to adapt to the 'new normal', it is relevant to conduct research on how people adapt to risks and disasters in view of COVID-19 to establish new prevention strategies according to the present.

Within the borough Venustiano Carranza in Mexico City, there are six regional faults, which were identified by gravimetric methods of the area [3]. Subsidence is due to physical and anthropogenic factors. Physical factors refer to granulometric characteristics of the material forming the area, while anthropogenic factors refer to accelerated growth of the urban area towards green areas, which in the last 30 years has been between 10 and 15 cm per year in the most critical areas.

The morphology of Peñón de los Baños hill [4] is that of a cinder cone originated from moderate basaltic volcanic explosions or intermediate gas release rates. At the top of the volcano is a crater of 2,300 m.a.s.l. [5] (Fig. 1).

According to the corresponding Statistical Bulletin [6], on March 18, 2020, the first confirmed case of mortality from COVID-19 in Mexico was reported. An excess of all-cause mortality was first observed in Epidemiological Week 12 (March 15–21) with a sustained increase until Week 21 (May 17–23). This week was not only critical at the national level

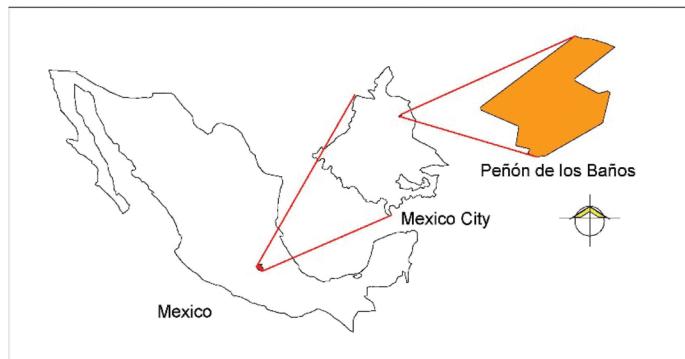


Figure 1: Peñón de los Baños location.

but also at the local level, as the first COVID-19 deaths in Peñón de los Baños were reported during this time as a result of carrying out the religious festivities in the town. The number of deaths has remained stable as of Week 21. The highest point was detected at Week 29 (July 12–18) having 107.2% all-cause mortality excess.

On the other hand, the first heavy rain in Peñón de los Baños fell down on February 14, 2020. A field visit was scheduled (this visit was planned in person with town's representatives at the town's kiosk in Niño Quemado park); however, it was cancelled on March 27 due to the COVID-19 contingency. For the May 5 festivity (commemorating the Battle of Puebla), population in Peñón de los Baños was suggested not to leave home due to said contingency and cancel the event. Some people ignored it and, despite the fact that the police arrived to stop the festivity, some residents opposed and continued celebrating.

Due to the COVID-19 contingency (May 20), face-to-face meetings were cancelled, and a decision was made to conduct a pilot survey regarding floods to residents in Peñón de los Baños, through town chroniclers (the survey was created using Google Forms and it was sent via WhatsApp for dissemination). As of May 23, the town chronicler (a person who knows and passes down town history from generation to generation) said that people were sad and unwilling to take part in the survey because 30 people died in the town in a single weekend

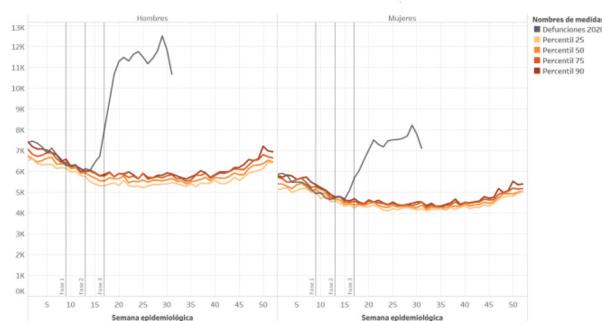


Figure 2: Endemic channel and all-cause mortality excess according to sex in 24 Mexican states (Week 31, 2020). (Source: [6].)

due to the May 5 festivity and May 10 celebration (Mother's Day). Deaths from COVID-19 continued to rise: over 60 deaths by June 2 and over 100 by July 23. People was afraid and was focused on the pandemic.

As a result of both problems, flood risk and COVID-19, a new survey (24 questions, created on Google Forms and shared via WhatsApp) was planned and conducted to know the population's priorities and how they act during a flood emergency, taking into account restrictions and possible proposals to address the problem between the population and the authorities.

2 POPULATION'S PERCEPTION OF FLOOD CAUSES IN PEÑÓN DE LOS BAÑOS

Due to the COVID-19 pandemic, meetings and workshops scheduled from March 2020 were cancelled (2 workshops had been planned: one to learn about flooding causes and problems and get closer to the population, and the other one to learn about town organization and how they address the problem). However, a pilot survey was conducted on the community, and, at the time of implementation, there was not much participation due to the number of deaths occurring in the town because the prevention measures were not followed. Such misfortune was triggered by the festivity held on May 5. Although only 10% of the population (approximately 200–300 people) took part in the festivity, this was enough to increase infections.

3 METHODOLOGY

The survey was restructured because fieldwork was not possible due to the COVID-19 pandemic. So, it was decided to conduct semi-structured interviews via WhatsApp on key people. These people were of help to know the general population's problems. This helped prepare a second survey more focused on the population in Peñón de los Baños, resulting in the rethinking of 31 questions. Survey objectives were to know flood causes; actions taken before, during, and after floods; and how the population would act in the face of floods and COVID-19, i.e., how they would evacuate if necessary.

4 SURVEY DESCRIPTION

This survey was made on Google Forms. It was divided into 5 parts: Part 1 contains questions concerning personal data, Part 2 is about their home, Part 3 is about floods, Part 4 is about flood actions, and Part 5 consists of a section about floods and COVID-19, given the state of things.

5 SURVEY RESULTS IN PEÑÓN DE LOS BAÑOS

Thirty-four (34) persons took part in the survey. Considering that the total population of Peñón de los Baños is 8,700 inhabitants [3], and that 2,175 of them experience flood risk, the sample represents 1.56% of the affected population. The predominant respondent's age is 40–49 years (29.4% of the total), which means, mostly adults, and a minority of young people under 18 years. It is worth mentioning that adults over 60 did not participate in the survey.

Generally, we noticed that the age for participation is over 22 years old – and up 59 years old. In terms of sex, women's participation is higher, with 2/3 of the total: of the 34 participants, 24 were women and 10 were men. Women's role is significant because they are the ones who are at home, informed of any flooding-related topics, and they organize themselves during an emergency, especially for picking up litter.

6 FLOODS

Part 3 of the survey consists of questions about floods. Figure 3 shows the results of floods faced by the population in Peñón de los Baños. Of these results, 88.2% of the population (30 homes) answered that they have faced floods and suffered their effects, and 8.8% (3 homes) answered that they have not faced floods but have suffered their effects, and only one home has not faced floods nor suffered their effects.

Figure 4 shows all the effects the population has detected due to floods: street flooding in 18 homes; courtyard or garden flooding in 17 homes; home flooding up to 0.5 m in 17 homes; home flooding ranging from 0.5 to 1 m in 6 homes; home flooding higher than 1 m in 8 homes. Then, in terms of the side effects caused by floods, of 34 respondents, 25 have lost property (furniture, i.e., refrigerator, dining room, stove), 17 have lost important documents, 16 have had health problems, 12 experienced drinking water shortages, merchants (14) got their food spoiled, 15 stated that there is no electricity and, finally, 9 mentioned other effects.

Regarding the time that the place has remained flooded, the respondents answered that they have usually been flooded for at least 1–3 h and, occasionally, for 1–3 days, which results in floods exceeding 50 cm high (Fig. 5). These floods usually occur in July, August, and September. This fact shows that at least it rains once during January, February, and March. For instance, in this year, it rained on February 14 and that was the first flood. The population attributes said rainfall to climate change.

Regarding flooding causes, 85.3% of the people (29) say terrain is the main cause of floods, especially in the lower part of Peñón de los Baños, since the water runs down from the hill. In second place, 70.6% of the people say drainage capacity is not enough; pipeline diameter is small, and water comes out of the drains. Other problems perceived by people as a flooding

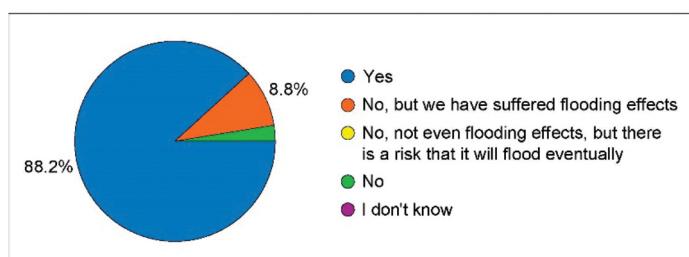


Figure 3: Floods and their effects.

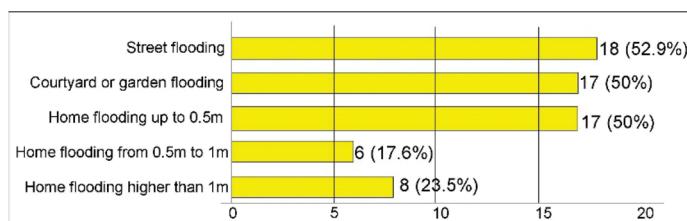


Figure 4: Flood impacts.

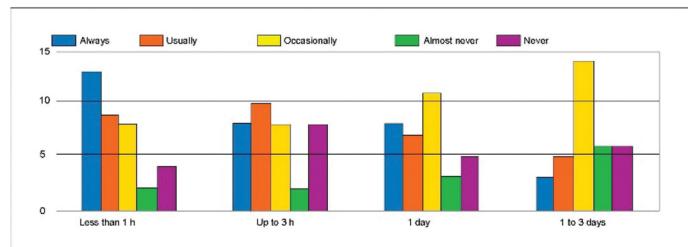


Figure 5: Flood duration.

cause are littering (67.6%), lack of maintenance and monitoring of the regulating reservoir (50%), and land subsidence, especially in the lower part of the hill, which is only perceived as a cause by 32.4% of the people. 20.6% of the people say floods are caused by the presence of the airport as airport water and drainage are diverted to Peñón de los Baños. Finally, only 2.9% of the people perceive having built subway line B as a cause of flooding. This is because the place level is lower, so it usually floods during rainy season.

7 FLOOD ACTIONS

As for flood actions, on a scale of 1 to 5 (1 being nothing prepared and 5 fully prepared), 41.2% of the people is not at all prepared, 58.8% is only somewhat prepared. Unfortunately, no person is fully prepared. Concerning the measures taken by the population to prepare for a flood (Fig. 6), the most significant action is picking up litter (67.6%), followed by other actions such as notifying the government (61.8%), moving household furniture to a higher level (58.8%), having an evacuation plan (38.2%), joining a WhatsApp network (52.9%) to report what is happening (especially in the streets), modifying housing structure (32.4%), such as stairs at the entrance to raise the level, or the erection of flood walls in entrances. When the flood lasts more than a day, 17.6% of people prefer to move house temporarily. As 8.8% perceive the lack of drainage capacity as a cause, they install additional drainage for their home. 1% do nothing and 1% move their car.

The alert before heavy rains in Peñón de los Baños is made through television, on the news (61.8%), through the internet (52.9%), through social networks such as Facebook and Instagram (35.3%), through usually affected groups in the community located in the lower part of Peñón de los Baños (29.4%), which use smartphone apps such as WhatsApp as it is the most common and used app by the population, and through radio (26.5%).

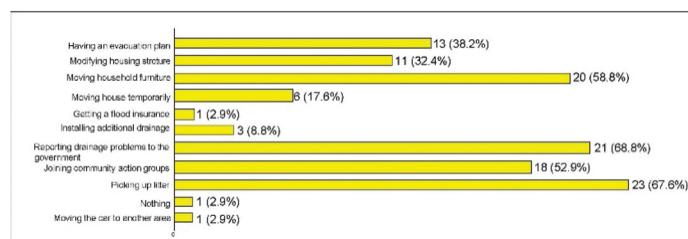


Figure 6: Population's prevention measures.

Phone calls are used only by 4.7% of the population. And 11.8% of the population is informed by neighbours when talking on the street, in shops, or in markets. 8.8% of the population does not learn of the flood until the problem is already there, and a small population, only 1%, uses newspapers. The population states that, during the time of the flood, they receive support from neighbours (66.7%, i.e., 22 responses out of 34), support from family and friends (60%), support from the mayor's office (36.4%), support from the Mexico City government (18.2%), and support from the local police (only 6.1%).

Arising from the support received by the population during floods, to know the neighbourhood relations that exist in the population regarding the issue, people were asked how much they knew their neighbours. The results obtained were: 60.6% have a good relationship with their neighbours, 30.3% only know their neighbours by sight, and 1% know their neighbours, but do not trust them (Fig. 7).

As for the relationship between people and the authorities, people were asked about their means to ask for help. Fig. 8 shows that people ask for help via telephone (39.4%), via WhatsApp (18.2%) (which is the tool that town population knows the most), through a person designated by the mayor's office (33.3%) (namely, city councillors, although the population says that they do not do their job well), through a neighbour or via email (1%).

Regarding the actions taken to mitigate flooding risk, the most significant action is drainage desilting (67.6%), as well as picking up litter (35.3%), followed by implementing early warning systems, installing devices such as panic buttons, and collecting rain data (23.5%,

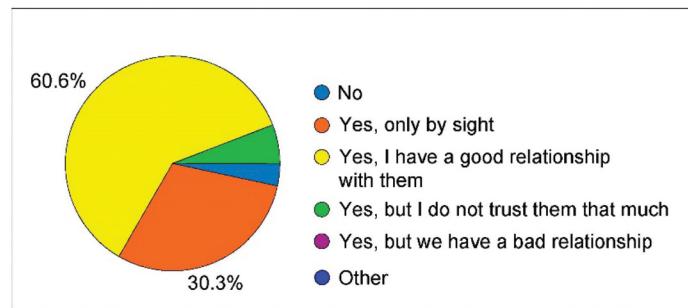


Figure 7: Communication and relationship with neighbours.

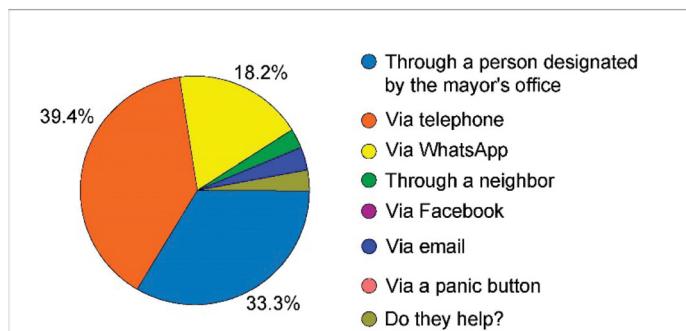


Figure 8: Means of communication to ask the authorities for help.

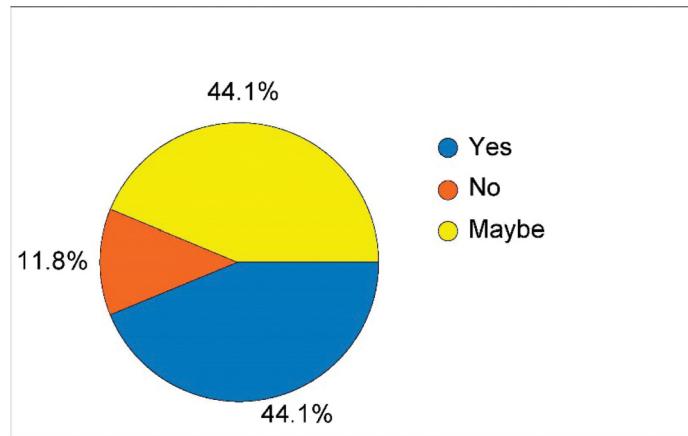


Figure 9: Interest in participating in community groups or social networks that give support on flooding-related topics.

each), installing video surveillance cameras (14.7%), devising and implementing prevention plans (8.8%), and developing apps and web pages (5.9%). Only 20.6% of the population makes home improvements.

After the questions concerning current people's participation and their relationship with the authorities, the questions that followed were about their possible participation in a community group or in social networks that give support during the floods. Figure 9 shows that 44.1% of the population said they are willing to participate, 44.1% said maybe they would participate, and 11.8% said they are not willing to participate.

Concerning the communication between people during the rainy season, people were asked if they would agree to install or test any monitoring system in their homes or some other technology. People responded that they would go for installing rain sensors (67.6%), installing more panic buttons (61.8%), installing video cameras (44.1%), using apps on smartphones (44.1%), using some drones (41.2%), and using loudspeakers such as those used for earthquake alerts (29.4%).

Finally, as it is a recurrent flooding area, the population was asked if they would use a shelter if it were installed. Figure 10 shows that 26.5% of people responded that they would only go to the shelter for groceries and information, 20.6% said they would go and sleep with

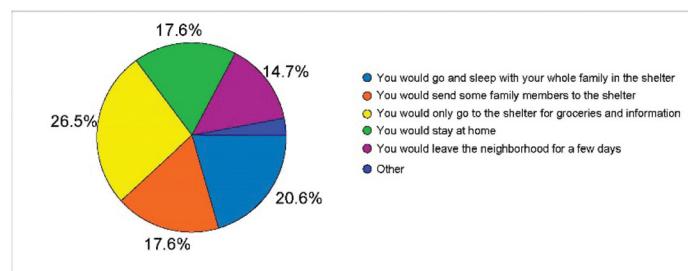


Figure 10: Shelter usage, if any.

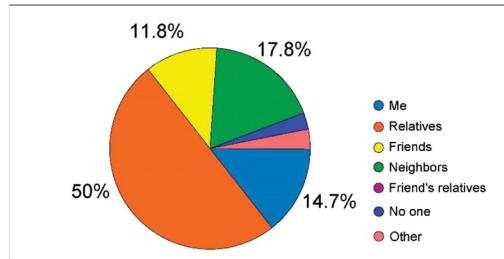


Figure 11: Knowledge of people who were sick with COVID-19 in Peñón de los Baños.

their whole family in the shelter, 17.6% said they would send some family members to the shelter, e.g., the elderly and children, while the rest of the family would stay to take care of home, and 14% said they would prefer to leave the neighbourhood for a few days and wait for the disaster to pass.

8 FLOODS AND COVID-19

Taking into account current pandemic situation, which has restricted our fieldwork, a section on floods and COVID-19 was included in the last part of the survey. Figure 11 shows that 50% of the people has had relatives sick with COVID-19, 17.6% of them have met people sick with COVID-19 in the town, 14.7% of them have been sick and have fortunately recovered from COVID-19, 11.8% of the population has had friends sick with COVID-19, and 2% of them have had no sick friend or acquaintance with COVID-19. As for deaths, 91.2% of the population knows people who have died of COVID-19, and only 8.8% of the population do not know people who have died of COVID-19.

The following questions were open-ended and focused on the issue of floods: If a flood were to occur, would you know how to act considering that there is COVID-19? Could you tell us in what way?

- *I'd go to my relatives' home, trusting in them and God.*
- *No. I don't know. I don't know how to act.*
- *As always. I'll get out of the neighbourhood and protect myself and my family.*
- *I have no idea.*
- *No. The only thing I'd do would be to have my family on the top floor and not leave the house.*
- *I'd inform the authorities.*
- *I'd try to get out of the place as soon as possible, wearing a face mask and a face shield.*
- *I think I'd take my relative to a health centre for protection and isolation from the rest of the family to avoid infection.*
- *The only thing we have been doing these last few months: Wearing a face mask and using hand sanitizer at all times. Physical distancing? I don't think so, but wearing a face mask at all times.*
- *I wouldn't know how to act. It'd be very difficult for me to leave because of my age and my health condition. I'd stay at home.*
- *I'd take the necessary measures to continue following the Department of Health's guidelines.*

9 FLOOD ANALYSIS

Although 90% of the population suffers flood damage, either directly for those living in the lower zone or indirectly for those living in the upper zone because they must pass through the lower zone to reach their homes, the first thing to be damaged is the streets, then the courtyard or garden and, finally, the home. Once water has entered the home, material and document losses are inevitable, followed by health damage from floodwater, lack of drinking water, and loss of food.

Once flooded, the water level takes from an hour to drop, at best, to three days, at worst. According to the population's perception, the causes are the terrain, insufficient drainage capacity, accumulation of litter in streets and drains, and a lack of maintenance of the regulating reservoir and its pumps because the problem remains despite having been operating for 10 years.

The interesting thing is that, despite the few or many efforts of both the population and the authorities during the rainy season, this cycle has been repeating year after year.

10 FLOOD ACTIONS AND MONITORING

As for prevention actions, a large part of the population (42%) is not at all prepared, a fact that draws attention because this problem is repeated on a yearly basis. In addition, 14% of the population performs some actions, i.e., picking up litter, and structural actions such as building concrete curb-like flood barriers at the home entrance and adding drains.

There is no local alert system so far. For this reason, the population resorts to the weather forecast news either on the radio or television. It is worth mentioning that more than 50% of the population has access to the internet and uses social networks.

Relationships among neighbours and relatives are good. The problem is the relationship with the authorities. As mentioned before, there is no good communication and no teamwork on this issue. Good communication only happens at the time of emergency via telephone or through a person designated by the same authorities or via WhatsApp, but among very limited people. WhatsApp is the type of communication that must be suggested to both parties to solve the problem, but by establishing a broad communication strategy.

The monitoring options that the population prefer the most are monitoring with local rainfall sensors, increasing panic buttons as there are only two – one of which does not work – placing cameras, which will be useful not only for flood monitoring but also for area safety. It is striking that 44% of the population agrees on using apps that would work for alerting on rainfall and flood probability – the population would be willing to use such apps by sending images and feedback. They also agree that work should be done at the same time to desilt drains and address the littering problem.

Finally, shelters are a recommended option but only for food collection because most of the population is not willing to leave their home, unless it is necessary because, as it is a dangerous area due to crime, they fear for goods.

11 FLOODS AND COVID-19

Since the pandemic is affecting worldwide, it was necessary to know the population's perception because, if a risk other than floods is added, what would the population do? i.e., what would be their priority?

It should also be remembered that Peñón de los Baños is a town that has been classified as a COVID-19 high-risk area since the beginning of the pandemic, and more than 200 deaths have been recorded in the area to date. At first, people did not believe the pandemic was real,

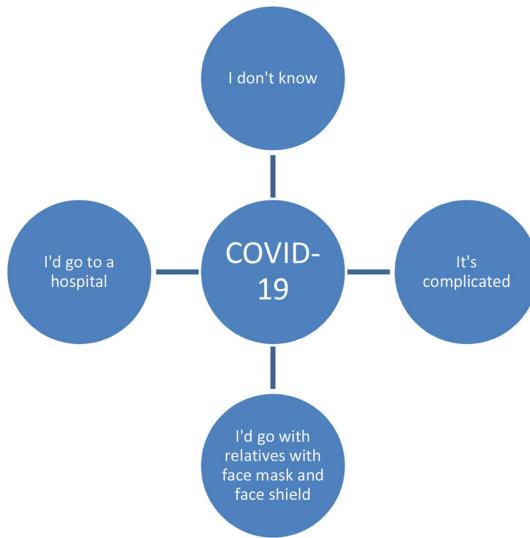


Figure 12: Floods and COVID-19 analysis.

but with the increase in deaths and cases, 50% of the population states that they have had at least one infected relative, and at least 92% have known of a dead person, which has made people more aware of the pandemic.

For this reason, people do not know what to do to face the current pandemic and floods (Fig. 12). People find it difficult to act. Some people prefer to go to their relatives' home considering safety measures such as face masks and face shields, always afraid of not being received or being infected. Afraid of the same risks, other people prefer to go directly to a hospital to be isolated so that they do not infect anyone or be infected.

12 CONCLUSION

There are recurring floods in the most part of Mexico City during the rainy season. This has led to addressing the issue concerning several items, but prevention phase is constantly developing. Therefore, causes, damage and actions are considered at the time of emergency to plan possible prevention strategies to be adopted by the population along with the authorities.

When COVID-19 reached Mexico in 2020, flood problem was not put aside, but the strategy to address it was changed. On the one hand, the pandemic stopped some processes, such as drainage extension field works. For Peñón de los Baños, where the population did not believe pandemic was real and continued living their lives as usual, a great number of deaths occurred in a town festivity because of the virus.

By the time the rainy season began, there had been many deaths among the population. The population then believed in the existence of COVID-19 and were in shock; they did not know what was more frightening, either the pandemic or the floods. They realized that, even if floods are recurring every year, things would change because of the pandemic.

Nevertheless, the population never stopped putting material losses first in the face of the flood risk, as they put their goods over their lives. It is noteworthy that the mix of rainy season and pandemic broaden their view and their behaviour in case of floods. They are aware that, if before the pandemic they could go with their relatives, now they must resort to shelters, at

least for the elderly and children and, in case of having symptoms, to leave their home and go straight to the hospital.

There is no doubt that both problems put people's lives at risk and both problems can be prevented. Therefore, populations such as the one in Peñón de los Baños where both problems occur, and which was a COVID-19 high-risk area during the first wave of the pandemic, set a precedent for the reflection on prevention measures. This is because, after losing many lives, the health protocol is being followed and they have tried to approach authorities for their needs so as to prevent reaching the emergency phase in the rainy season.

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