THE PIGEON VALLEY FIRE: A QUESTIONNAIRE STUDY ABOUT THE EVACUATION PROCESS

June 2021

Fire and Emergency New Zealand Research Report Number 183

ISBN Number 978-1-92-728747-7
ISSN Number 2703-1705

Lovreglio, R., Nilsson, D., Kuligowski, E., Cain, L., Walpole, E., Johnston, D. & Rothas, F. (2021). The Pigeon Valley Fire: A questionnaire study about the evacuation process? (Report No. 183). University of Canterbury and Massey University, NZ: Fire and Emergency New Zealand.

This research was commissioned by Fire and Emergency New Zealand and undertaken by independent researchers. Publication does not indicate Fire and Emergency New Zealand's endorsement of the findings or recommendations.

The Pigeon Valley Fire: A questionnaire study about the evacuation process

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Report title: The Pigeon Valley Fire: A questionnaire study about the evacuation process
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Number of pages: 38
Illustrations: Ruggiero Lovreglio
Funder: Fire and Emergency New Zealand

Keywords: Pigeon Valley Fire, Wildfire, WUI, Evacuation, Human Behaviour in Fire, Risk Perception, Preparedness, Households

Abstract: Wildfires are an increasing threat around the world, as they have started occurring in areas not traditionally associated with wildfire risk, e.g., Sweden and New Zealand. To address this changing threat, it is important to understand how people perceive wildfire threat and respond to them. This study aims to investigate the evacuation process during the Pigeon Valley Fire. This fire occurred in February 2019, and it was the largest New Zealand wildfire in recent years. Almost 3000 people were required to evacuate, i.e., they were in evacuated areas.

In this study, a questionnaire was used to collect data from 152 of the households living in evacuated areas, which represents around 16% of the study population (assumed average household size of 3.2 persons). The majority of questionnaires were filled out in person using a tablet, with a handful of questionnaires filled out online. Respondents filling out the in-person questionnaire received a shopping voucher worth 20 New Zealand Dollars (NZD), whereas respondents filling out the questionnaire online did not receive any reimbursement.

The questionnaire focused on the perception of fire risk and the subsequent household response. Data suggests a relatively low level of risk awareness and wildfire preparedness, although risk awareness was higher for rural than urban communities. Households received direct warnings by authorities and/or second-hand information by family, neighbours or friends. The main information channels were face-to-face, text, internet and social media. However, some groups did not have easy access to warnings due to technological issues, e.g., not having the appropriate mobile devices to easily access issued warnings. The data also suggests that almost everyone perceived physical fire warnings during the Pigeon Valley Fire.

The majority (96%) of surveyed households followed the evacuation order, and it took them approximately one hour to prepare before starting to evacuate. The households used this time to pack, secure their home and decide where to evacuate. The households who did not evacuate (4%) did so to protect (or defend) their property, do their job, take care of pets/livestock, or did not believe their area/property was at risk.

The study shows that authorities, e.g., Nelson Tasman Civil Defence and Emergency Management Group, Fire and Emergency New Zealand, and New Zealand Police, played key roles in informing the household about the wildfire and the required actions. The study also reveals areas of future development, such as increased help to people with disabilities and technological issues related to the delivery of warnings.

Table of contents

1. Introduction

Wildfire is a growing global concern for rural and urban areas (Boustras, Ronchi, & Rein, 2017). Statistics show that the frequency and consequence of wildfire have increased in recent decades, creating serious challenges for fire and emergency services, as well as communities in the transition zone between wildland and human development, i.e., the Wildland-Urban Interface (Liu, Stanturf, & Goodrick, 2010; Mccaffrey, Wilson, & Konar, 2018; Ronchi et al., 2017). As an example, 85 people lost their lives in California's Camp Fire, which made 2018 the deadliest US wildfire year in a century (Wootson, 2018).

Wildfires have started occurring in areas not traditionally associated with wildfire risk, e.g., Sweden and new parts of New Zealand (Pearce, 2017; SCION, 2011). For instance, in February 2019, the Pigeon Valley Fire was the largest New Zealand wildfire in the past decade and required almost 3000 people to evacuate from a large land area. Figure 1.1 shows the extent of the Pigeon Valley Fire, as well as the areas ordered to evacuate or ordered to get ready to evacuate. While the reader is referred to the report by Australasian Fire and Emergency Service Authorities Council (AFAC 2019) to learn about the different fires occurring in the Nelson area in 2019, this study focuses only on the Pigeon Valley Fire.

The Pigeon Valley Fire resulted in many evacuation related challenges. Several media sources, such as One News (2019) and Radio New Zealand (2019), reported that immediate information to the public lacked in spite of the severity of the fire. Another challenge was the saving of pets and livestock (McDonald, 2019), which delayed evacuation.

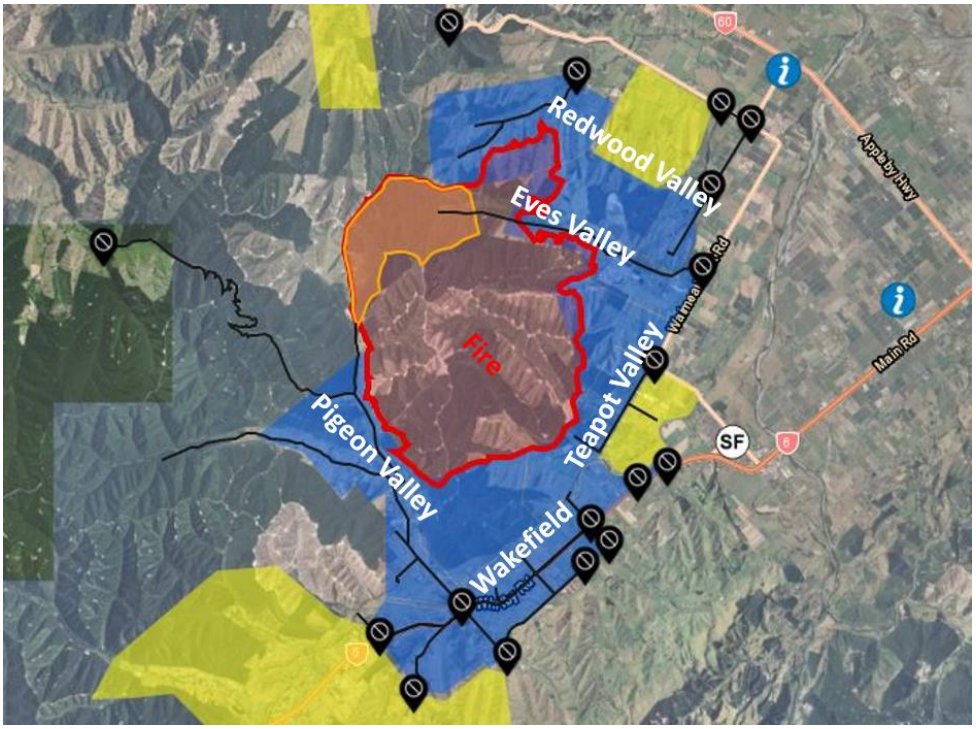


Figure 1.1 – The map showing the extent of the Pigeon Valley Fire (red), the evacuated area (blue) and the ready-to-evacuate areas (yellow). This figure was taken from the New Zealand Civil Defence (2019) on 11 February 2019.

To date, only a handful of studies have been carried out to investigate how people behave in wildfire evacuation in New Zealand. Jakes et al. (2010) investigated the wildfire evacuation of the 150-300 residents affected by the Christchurch Wildfire in 2003. The study shows that people who are long-time residents at their property wanted to stay and defend their property because they perceived the evacuation as unnecessary or believed that staying and defending their property was a more "productive" response. Jakes and Langer (2012) investigated the same wildfire showing

how households required preparation time to load their vehicles and move livestock. McGee and Langer (2012) studied the behaviour of the households affected by the wildfire in the Karikari Peninsula in 2011. This study illustrates different responses, including evacuating, staying to defend, or taking shelter at a nearby beach. Finally, Langer et al. (2018) and Squance et al. (2018) studied the Port Hills wildfire evacuation affecting 1400 residents in 2017. This event highlighted the potential impact of animals on their owners' evacuation decisions in wildfire emergencies.

Although the research mentioned above has focused on past wildfire evacuations in New Zealand, investigating the evacuation behaviour during the Pigeon Valley Fire represents a unique opportunity to expand the existing body of knowledge. More specifically, it is essential to understand the evacuation process, e.g., to learn what made people decide to evacuate and how they made decisions during the Pigeon Valley Fire. The knowledge gained can be used to improve evacuation procedures for future wildfire events in New Zealand and around the world.

1.1 Objective and goal

The study's main objective was to investigate how people in evacuated areas, as a result of the Pigeon Valley Fire, perceived the wildfire threat and responded to it. Furthermore, the objective was to explore the wildfire preparedness of affected households.

The goal is to increase the understanding of wildfire evacuation in the New Zealand context and to provide insights for future research, evacuation management and communication.

1.2 Report outline

This report consists of six chapters and an appendix. In the appendix, the use of boxplots in this report is explained.

In chapter 1 (Introduction), the research problem is highlighted using existing literature. The first section also contains the research objectives and goals, as well as an outline of the report.

In chapter 2 (Pigeon Valley Fire Timeline), an overview of the evacuation timeline for the Pigeon Valley Fire is provided. The timeline is based on information reported by AFAC (2019) and the Ministry of Civil Defence and Emergency Management (MCDEM, 2019)

The third chapter (Method) first describes the characteristics of the household sample. The questionnaire tool and the data collection approach are then described.

Chapter 4 (Results) presents the quantitative results of the study, namely the fire preparedness of the households, the warning and fire cues[1] received, as well as the response to the fire. The chapter ends with a qualitative thematic analysis of the open comments provided by households.

Chapter 5 (Discussion) discusses the main finding of the study, possible insights and the study's limitations.

In chapter 6 (Conclusions), the main conclusions of this study are presented.

[1] Fire cues are environmental cues which includes flames, embers, smoke, winds, and heat, orange or red glow in the sky and falling ash (Walpole, Kuligowski, Cain, Fitzpatrick, & Salley, 2020).

2. Pigeon Valley Fire Timeline

This section provides an overview of the fire spread and evacuation timeline of the Pigeon Valley Fire. This timeline is based on the information reported by AFAC (2019) and MCDEM (2019).

The Pigeon Valley Fire ignited in Pigeon Valley on Tuesday 5 February 2019 at 14.10 (approximately) and quickly developed on farmland. The Pigeon Valley Fire spread in different other valleys over the following days as illustrated in Figure 1.2.

The timeline for the Pigeon Valley Fire is given below.

- Tuesday 5 February 2019
    - 14.10 (approximately) - The Pigeon Valley Fire ignited in Pigeon Valley and quickly developed on farmland.
    - 14.15 - The alarm was given by a call to the 111-emergency call.
    - 16.52 - Police were handling evacuations in the Eves Valley and the ridge of Teapot Valley as the properties located within these areas were at risk.
    - 22.09 - Redwood Valley residents were required to evacuate.
    - By the end of the day - Residents from over 100 properties were evacuated or self-evacuated from Pigeon Valley
- Wednesday 6 February 2019
    - 8:00 - The state of local emergency was declared for the Nelson Tasman Civil Defence Emergency Management in line with the rules established in the *Civil Defence Emergency Management Act* (2002). This state was in place until the 27 February 2019.
- Thursday 7 February 2019
    - 22.13 - Fire and Emergency NZ sent an Emergency Mobile Alert to Wakefield residents to inform them on the possibility of an evacuation.
- Friday 8 February 2019
    - 13.00 – Residents from Wakefield and the rest of Pigeon Valley were evacuated.
- Monday 11 February 2019 - Wakefield residents were allowed to return.
- Thursday 14 February 2019
    - 08:00 - residents in some parts of Pigeon Valley were allowed to return.
- Phased return of other valley residents occurred over the next week.
- Friday 22 February 2019 - Conditional re-entry of the last remaining evacuated.
- Monday 25 February 2019 - All cordons were lifted.

The fire and evacuation timelines highlight that most of the rural areas (i.e. valleys) evacuated in the first day of the emergency (5 February 2019) given the rapid spread of the fire. These evacuations took place before the state of local emergency was declared the following day (6 February 2019) by the Civil Defence. The timeline shows that Wakefield, the main urban area evacuated in the disaster, and part of the Pigeon Valley were evacuated two days after the state of local emergency was declared (8 February 2019). The night before (7 February 2019) these areas were alerted that they might need evacuate.

The Pigeon Valley Fire did not result in any human casualties. However, the physical and economic damage to property in the region was extensive (AFAC, 2019).

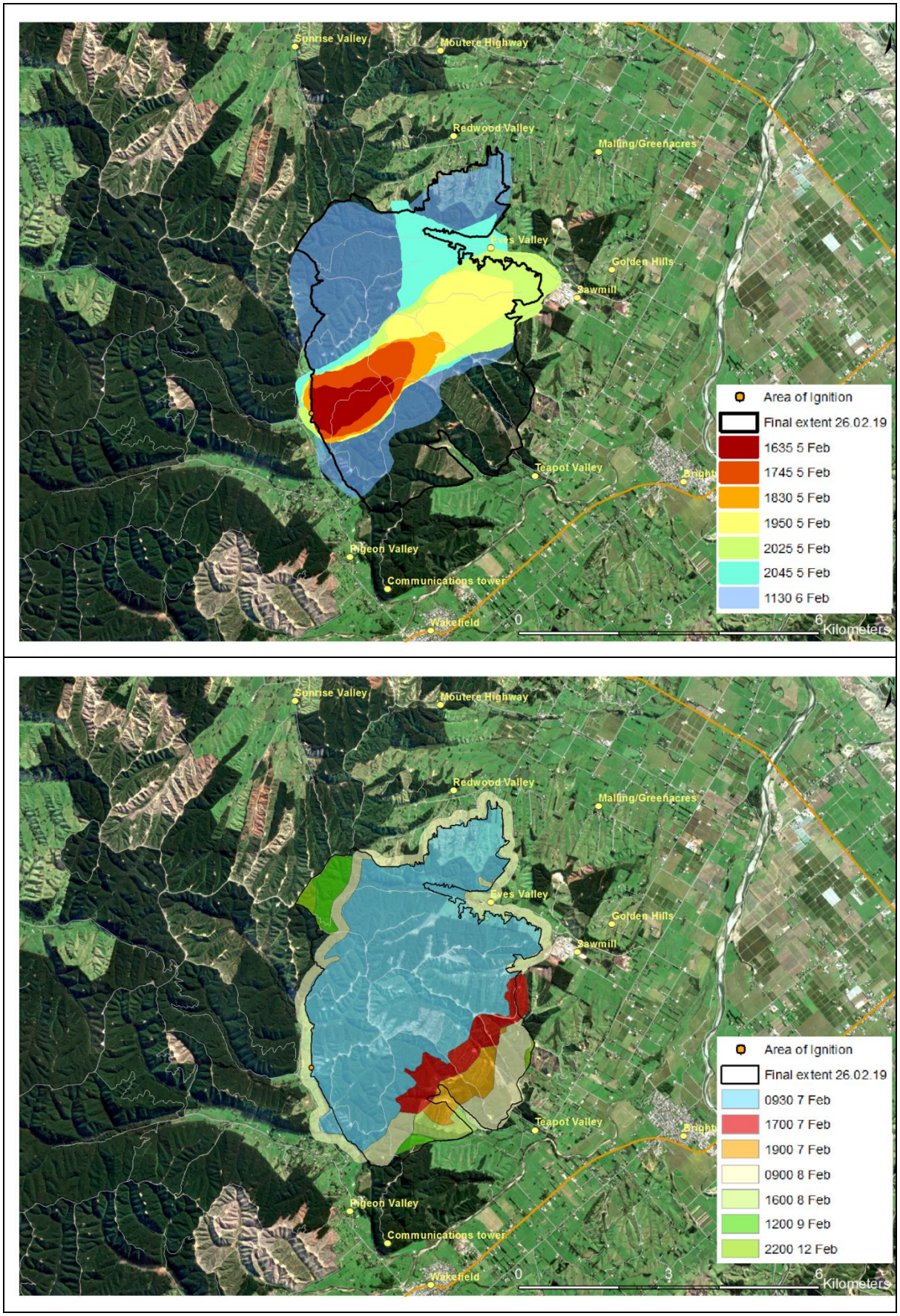


Figure 1.2 – The map showing the spread of the Pigeon Valley Fire from the 6 February 2019 to the 12 February 2019. These figures were taken from the original one published in AFAC (2019).

3. Method

The data collection was carried out in the areas affected by the risk of fire (Pigeon Valley, Eves Valley, Teapot Valley, Redwood Valley, and Wakefield) with a door-to-door and an online questionnaire. The questionnaire was based on a wildfire questionnaire from the National Institute of Standard and Technology (NIST). This questionnaire, which was originally used for a wildfire in the USA (the Chimney Tops 2 Fire), was modified to better fit the New Zealand context and the Pigeon Valley Fire (see Section 3.2 Questionnaire).

3.1 Sample

The questionnaire was filled out by 168 respondents representing 168 households. However, 16 households were not in evacuated areas, so they were excluded from the analysis. Therefore, the analyses carried out in this study are based on the 152 respondents who were affected by the Pigeon Valley Fire as they were living in evacuated areas.

The place of residence for the 152 included respondents, i.e. household locations, at the time of the fire is given in Figure 3.1. This shows the majority of respondents (60%) lived in Wakefield.

This sample size is deemed sufficiently large to draw conclusions about people's perception and response following the Pigeon Valley Fire. The fire affected almost 3000 people (study population), and data were collected from 152 households. Given an average household size of 3.2 (see Figure 3.3), the investigation gathered information on more than 486 people, i.e., the study sample is approximately 16% of the study population.

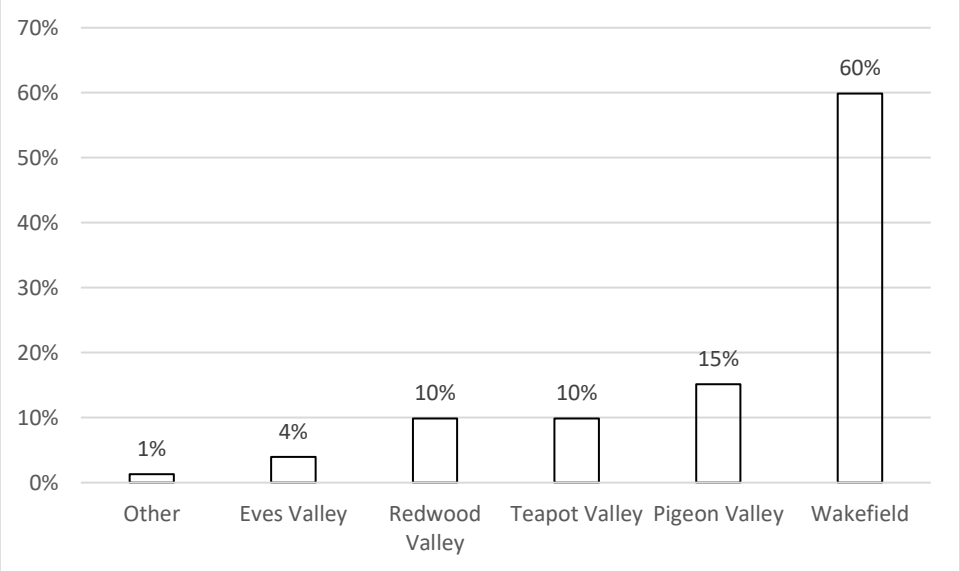


Figure 3.1 – Areas where the respondents lived at the time of the fire

The questionnaire was filled out by 61% women and 39% men. The composition was 92% European/Pākehā, 5% Māori and 2% of other ethnicities, which is in line with the statistics provided by Statistics New Zealand for the Tasman Region (StatsNZ, 2013). Figure 3.2 shows the respondents' age, education, and employment, as well as the total household income before tax.

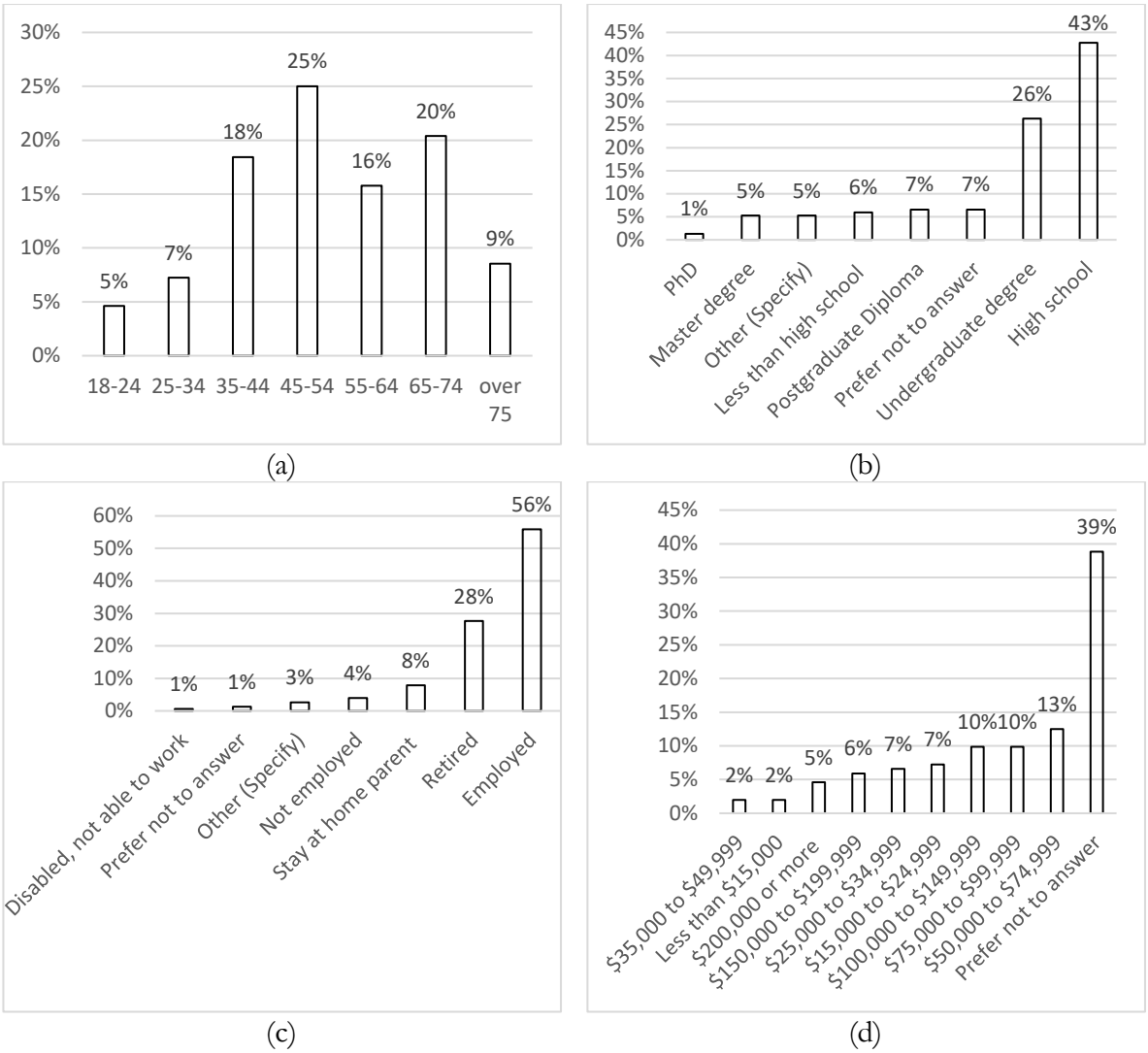


Figure 3.2 – Respondents' (a) age, (b) education, (c) employment, and (d) total income of the household before tax

The family size distribution of the households is shown in Figure 3.3. This figure shows that the average family size is 3.3 (see x symbol) while 25% of the sample has family size up to 2 and 25% of the sample has family size equal or granther than 4. The range of family size goes from a minimum of 1 to a maximum of 7. The figure identifies 3 outliers showing three household having a family size of 8, 10 and 12. Further info on how to read boxplot is reported in the Appendix. The percentages of the family members are illustrated in Table 3.1. Thirty-one per cent of households stated that at least one household member had a medical condition at the time of the fire. As can be seen in the table, 38% of the households had young people aged under 12, and 16% had young people aged between 13 and 17 years. Finally, Table 3.1 indicates that 34% of the households had people aged above 65.

Table 3.1 – Household structure

Family members	**Percentages**
Children (0 - 12 years)	38%
Children (13 - 17 years	16%
Adults (18 - 64 years)	78%
Adults (65 years and older)	34%

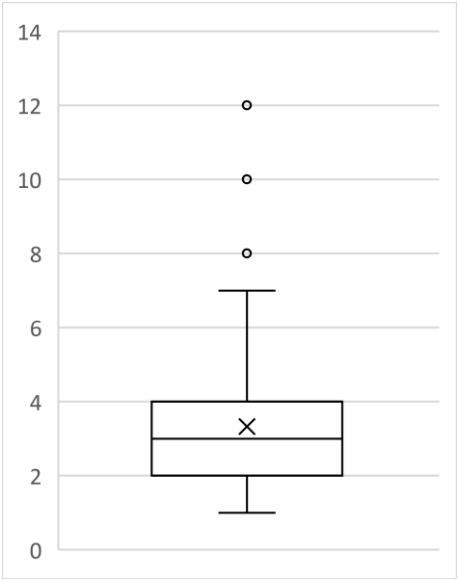


Figure 3.3 – The household size

Seventy-three per cent of respondents had animals: 63% had pets, and 36% had livestock or other farm animals. There were only five households with more than 100 livestock animals. The distribution of the pets and livestock animals (excluding the 5 data points greater than 100 for livestock) are shown in Figure 3.4.

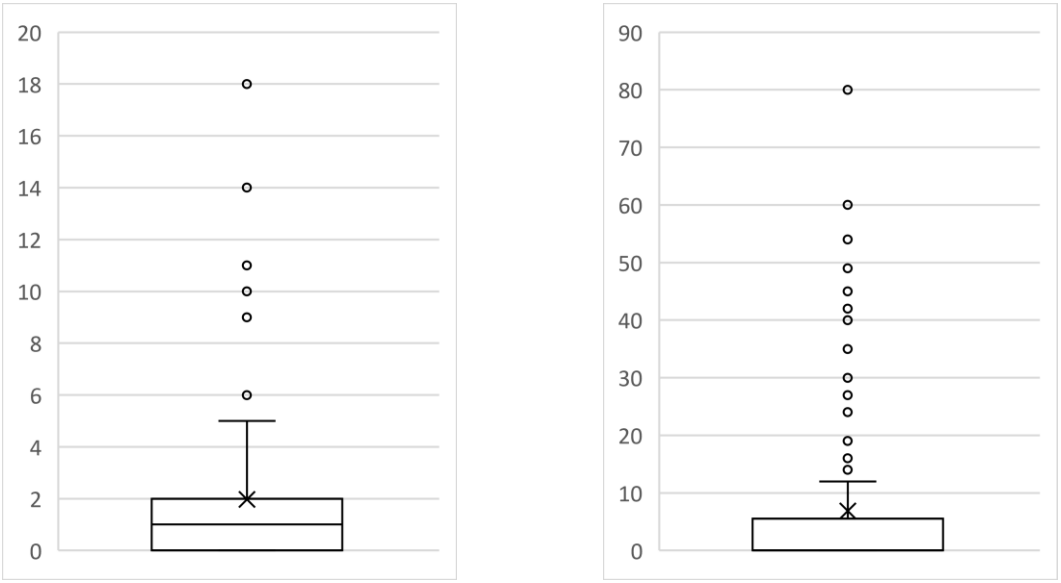


Figure 3.4 – Distribution of (a) pets and (b) livestock animals (excluding the 5 data points greater than 100 for livestock)

The type of areas, the ownership and the time spent in the property before the Pigeon Valley Fire are shown in Figure 3.5.

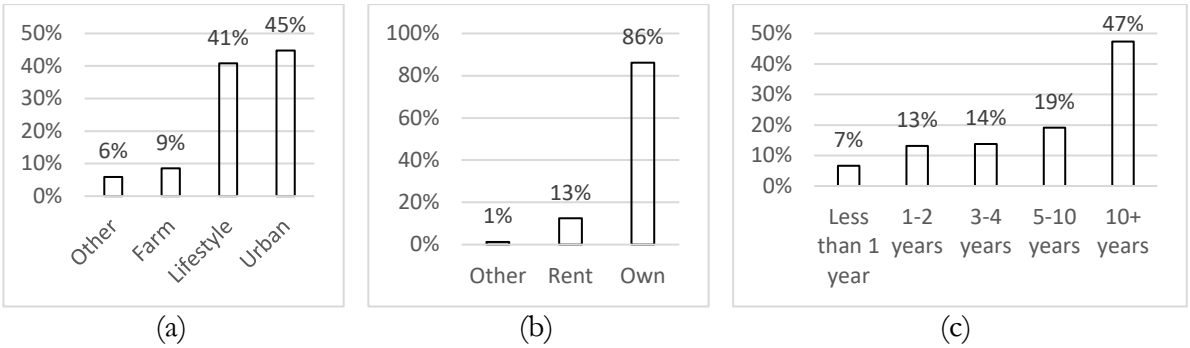


Figure 3.5 – The type of (a) areas, (b) ownership, and (c) time spent in the property

3.2 Questionnaire

The questionnaire, called the NIST household survey, was originally designed at NIST to investigate the behaviour of people affected by the Chimney Tops 2 fire (Kuligowski & Walpole, 2020). The NIST household survey was developed to collect data on a variety of factors identified in wildfire evacuation literature as influential on both risk perception and the decision to evacuate, i.e., as outlined in the warning response model (Mileti & Sorensen, 1990) and the Protective Action Decision Model (Lindell & Perry, 2012). The first step in survey development was to gather surveys from other wildfire evacuation studies both in the USA (Sorensen, Sorensen, Smith, & Williams, 2009) and in Australia (McLennan, Elliott, Omodei, & Whittaker, 2013; Strahan, Whittaker, & Handmer, 2017) as well as an additional survey conducted by the US Army Corps of Engineers (US ACE) on evacuation behaviour during the 2017 Oroville dam break (Sorensen, Mileti, & Needham, 2017). Certain questions or sets of questions from all four surveys were adapted to eventually develop the NIST household survey (Kuligowski & Walpole, 2020).

In this study, the NIST household survey was modified for the Pigeon Valley Fire by changing several of the response options of the questions and re-phrasing some questions to better fit the New Zealand context. For example, changes were made to questions about the education level of households and household income level, e.g., USD to NZD. In addition, multiple-choice questions about the organisations managing the fire emergency were changed to fit the New Zealand context, and questions related to when people acted were adjusted to the Pigeon Valley Fire timeline.

The questionnaire assessed pre-event variables, such as:

- *risk perception,*
- *preparedness actions,*
- *previous experience in a wildfire evacuation,* and
- *demographics (i.e., gender, race/ethnicity, age, education, income, employment, family size and number of pets/livestock, medical conditions, length and type of residence [rent/own]).*

The survey also assessed variables associated with the fire event. For households who received warnings (referring to any official or unofficial information from the emergency services, media, or personal contacts such as friends, relatives or co-workers), information was collected on the:

- *receipt of the first warning and/or additional warnings (and the total number of warnings received),*
- *respondents' characterisation of that warning, including content, dissemination method and source,* and
- *location, day and time when the warning(s) was received.*

After answering questions on warnings, and even if respondents did not receive warnings, respondents were directed to a section of the survey that asked about fire cues. The survey collected information on:

- *types of fire cues received,* and
- *day and time when the cue(s) was (were) received.*

After each set of questions regarding warnings or cues, respondents were asked about the immediate reaction.

Finally, the survey assessed the decisions made in response to the wildfire event, including:

- *deciding to stay in place or deciding to evacuate,*
- *day and time of this decision,*
- *actual protective action taken, i.e., stay in place or evacuate,*
- *reasons for taking that action,* and
- *any pre-evacuation actions between first warning/cue and taking action.*

Additionally, data were collected on respondents' perceptions of threat and risk at various times in their decision-making process (i.e. after receiving the first warning, after perceiving fire cues and at the time of the decision to evacuate or stay in place) using scales adapted from the US ACE survey (Sorensen et al., 2017). In the final question of the survey (called open comment), participants were encouraged to add any comments they might have in relation to the Pigeon Valley Fire.

3.3 Data collection

The data were collected between 18th September and 8th October 2019. The data collection was mainly performed in-person, i.e., door-to-door, with a limited number of responses obtained via online participation (11 out of 152 responses). For in-person surveys, the respondents were asked to fill out the questionnaire using a tablet. The online version of the questionnaire was shared on social media, e.g., Facebook, Twitter and LinkedIn. The link to the questionnaire was shared by the authors using social media groups created by the public during the emergency.

Data was collected from one person per household. The questionnaire took between 20 and 30 minutes to complete. Respondents who filled out the in-person version of the questionnaire were given a shopping voucher worth 20 NZD. Online respondents did not receive any reimbursement.

4 Results

In this chapter, respondents' answers to the questionnaire described in Section 3.2 are presented. The results are grouped into fire preparedness (see Section 4.1), first warnings (see Section 4.2), additional warnings and fire cues (see Section 4.3) and response (see Section 4.4). Open comments provided by respondents are presented in the last section (see Section 4.5).

In the following sections, ***urban area*** refers to Wakefield (population density of 257.5 people/km^2 (City Population, 2019) while ***rural area*** refers to all other marked areas in Figure 1.1. The data of rural and urban areas are compared for all questions in which respondents could only select one answer from a list of possible response options.

The decision to compare urban and rural households is based on existing research, which suggests differences between urban and rural communities in terms of the perceived risk of disasters and response to disasters (Cutter, Ash, & Emrich, 2016; Kapucu, Hawkins, & Rivera, 2013; Rivera & Kapucu, 2015). For the urban and rural populations, results have been compared using Chi-Square tests, Fisher's exact test and Mann-Whitney U to determine if statistically significant differences exist. A significance level of 5% has been used in all tests (α=0.05).

4.1 Fire Preparedness

One question explored whether the respondents had been aware, before the Pigeon Valley Fire, that a wildfire might threaten their communities. The question was:

Before the Pigeon Valley Fire, did you know that wildfires could be a problem in your community?

Table 4.1 shows that 55% of all respondents were indeed aware of possible wildfire risk. Notably, a large proportion of respondents from rural areas (68%) indicated that they knew that wildfires could cause problems in their communities. In comparison, less than half of the respondents from the urban area (46%) stated that they had been aware that wildfires could be a problem in their area. A Chi-Square test (X^2 (1, N = 152) = 7.537, p = .006) indicated a significant difference in awareness between urban and rural responses, with a higher number of rural respondents being aware of wildfire risk.

Table 4.1 – Awareness that wildfires could pose a problem for the community before the Pigeon Valley Fire

Response	Rural	Urban	Total
No	19 (32%)	50 (54%)	69 (45%)
Yes	41 (68%)	42 (46%)	83 (55%)

The respondents were asked about the perceived likelihood of a wildfire threatening their property. The question was:

Before the Pigeon Valley Fire, how would you have described the possibility that a wildfire would threaten your property? (no possibility [1] to very good possibility [5])

As can be seen in Figure 4.1, respondents from the urban area saw only a slight possibility or even no possibility that a wildfire could threaten their properties (average score of 2). In comparison, people from the rural areas perceived a higher possibility that a wildfire would threaten their property (average score of 2.9). A Mann-Whitney test U (U=1459.5, N=147, p=0.000) indicated a significant difference in perceived possibility between urban and rural responses, with those in rural areas having a higher perception of wildfire risk.

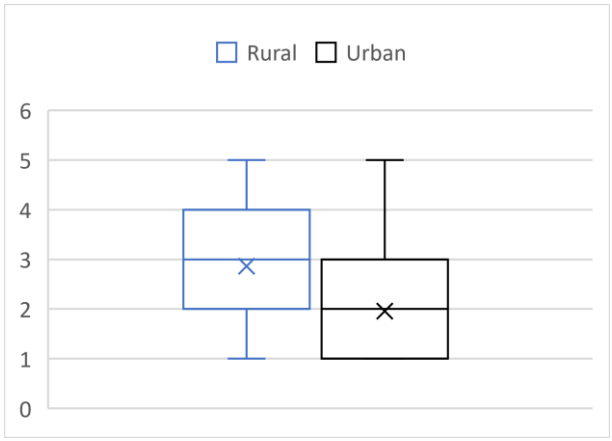


Figure 4.1 – Distribution of the perceived possibility that a wildfire would threaten respondents' property.

One question explored whether the households had put any measures in place to protect their residence from wildfires. The question was:

> *Prior to the Pigeon Valley Fire, had you or others (e.g., family, friends, businesses) taken any measures to protect your residence from wildfires?*

Table 4.2 indicates that, regardless of area, the majority (75%) had not taken any protective measures before the wildfire. Consequently, nearly 25% of all households had taken measures to protect their properties from the threat of a possible wildfire. A Chi-Square test (X^2 (1, N = 152) = 24.819, p = 0.000) indicated a significant difference in preparedness activities between urban and rural responses, with a higher proportion of rural households having taken preparative measures. Figure 4.2 shows the measures taken by households (rural and urban combined).

Table 4.2 – Measures been taken to protect property from wildfires before the Pigeon Valley Fire

Response	Rural	Urban	Total
Measures were taken	28 (47%)	10 (11%)	38 (25%)
No measures were taken	32 (53%)	82 (89%)	114 (75%)

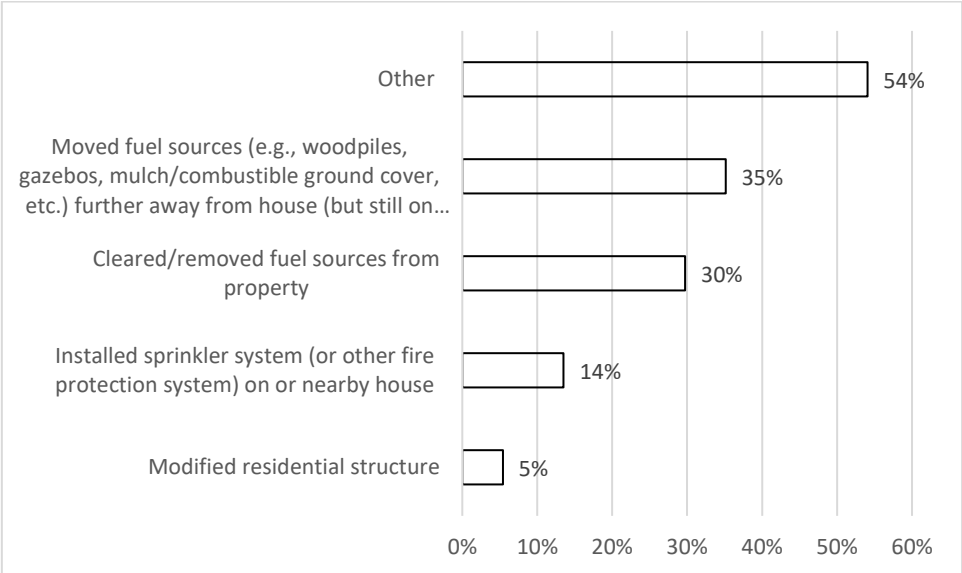


Figure 4.2 – Type of measures taken to protect property before the Pigeon Valley Fire (n = 37)

The respondents were also asked about the existence of a household emergency plan specially dedicated to wildfires. The questions were:

Did you have a household emergency plan (such as a verbal agreement or a written plan) for wildfires in place before the Pigeon Valley Fire?

What was the ultimate goal of this household emergency plan?

Only a minority of the respondents (14%) stated that they have worked out a wildfire emergency plan before the Pigeon Valley Fire (see Table 4.3). A Chi-Square test (X2 (1, N = 148) = 0.991, p = 0.320) indicated no significant difference in plan making between rural and urban responses. The overall goals of the established emergency plans can be seen in Figure 4.3. The most common goal of the plan was to evacuate the family (90%), which was followed by the evacuation of pets (20%).

Table 4.3 – Existence of a household emergency plan before the Pigeon Valley Fire

Response	Rural	Urban	Total
No, we had no plans	49 (83%)	79 (89%)	128 (86%)
Yes, we had a plan	10 (17%)	10 (11%)	20 (14%)

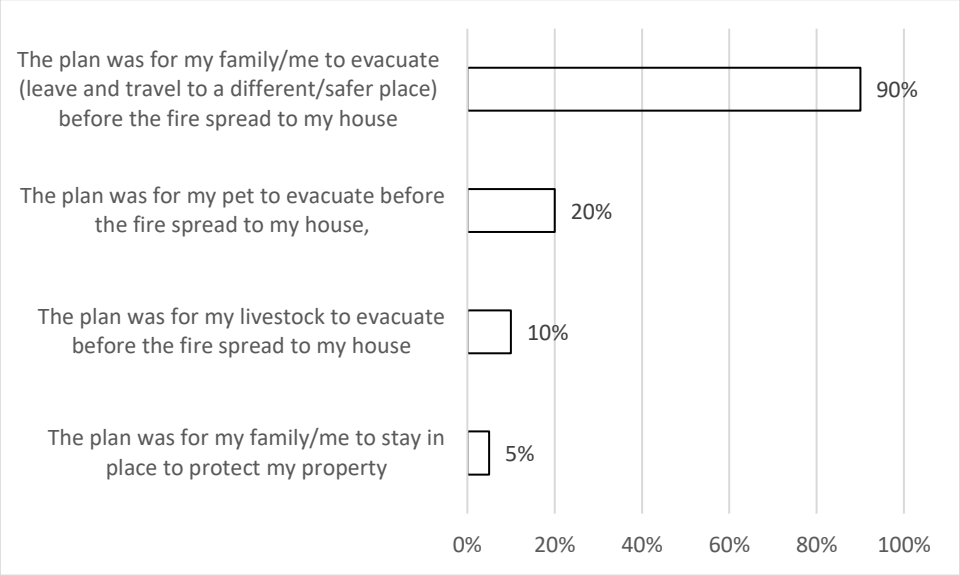


Figure 4.3 – Goals of the established household emergency plan (n = 20)

4.2 First warning

Several questions were asked to investigate if respondents had received any warning (i.e. any information (official or unofficial) from the emergency services, media, or personal contacts such as friends, relatives or co-workers) and the types of warning received. This section indicates 88% of households (n = 134) reported receiving any warnings about a wildfire that could threaten their area (see Table 4.3). A Chi-Square test (X^2 (1, N = 152) = 12.539, p = 0.000) indicated a significant difference in received warnings between urban and rural responses, with a higher proportion of urban households receiving a warning.

Table 4.3 – Receiving warnings about a wildfire that could threaten their area

Response	Rural	Urban	Total
No	14 (23%)	4 (4%)	18 (12%)
Yes	46 (77%)	88 (96%)	134 (88%)

One question explored when the respondents received the first warning. The question was:

When did you receive the first warning?

According to Figure 4.4, most of the respondents from the rural areas (58%), as well as the urban area (33%), received the first warning on 5 February in the afternoon. However, 24% of respondents from the urban area also indicated that they had received their first warning on 7 February.

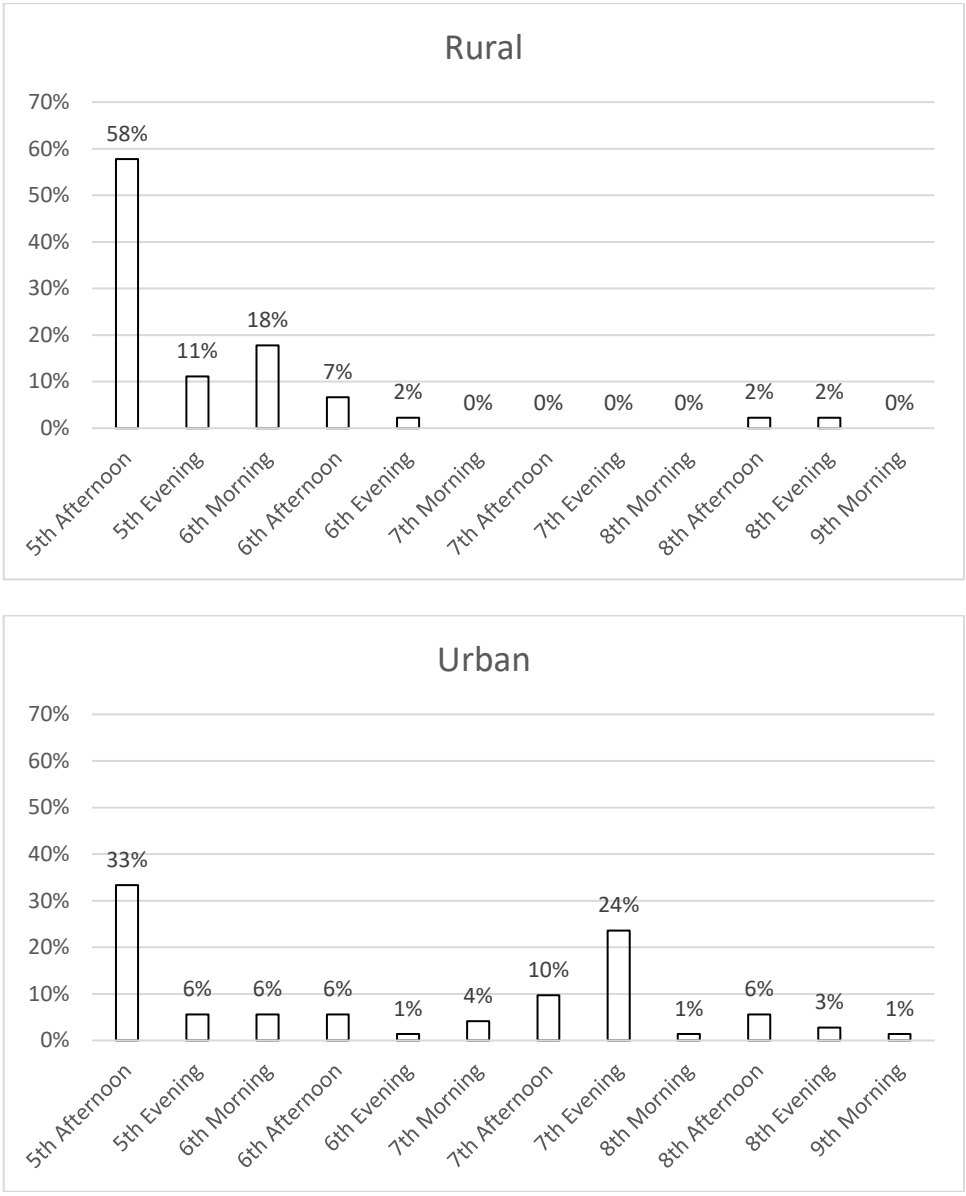


Figure 4.4 – Date/Time of first warning received in rural areas (n = 45) and urban areas (n = 72).

The study also investigated the nature and content of the first warning received using the following questions:

Think back to that very first warning you received. How would you characterise this first warning?

What was the content of the first warning?

Figure 4.5 illustrates that many respondents classified their first waring as *"information only"* (46%), *"official (or mandatory) order to prepare to evacuate"* (31%) and *"recommendation (or voluntary order) to evacuate"*

(16%). As can be seen in Figure 4.6, the main contents of the first warning were identified as information about the *"wildfire location"* (61%) as well as *"wildfire severity"* (49%).

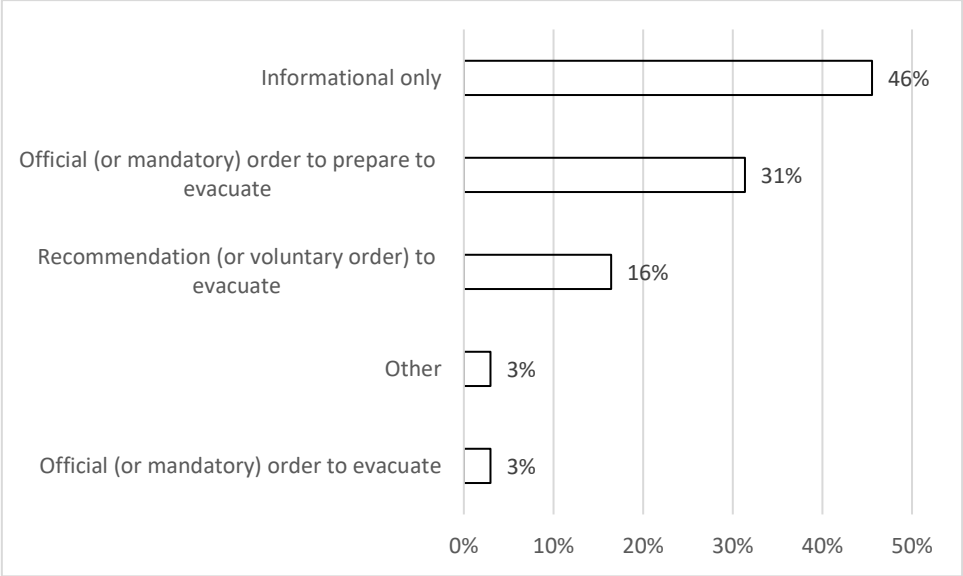


Figure 4.5– Type of first warning received (n = 134)

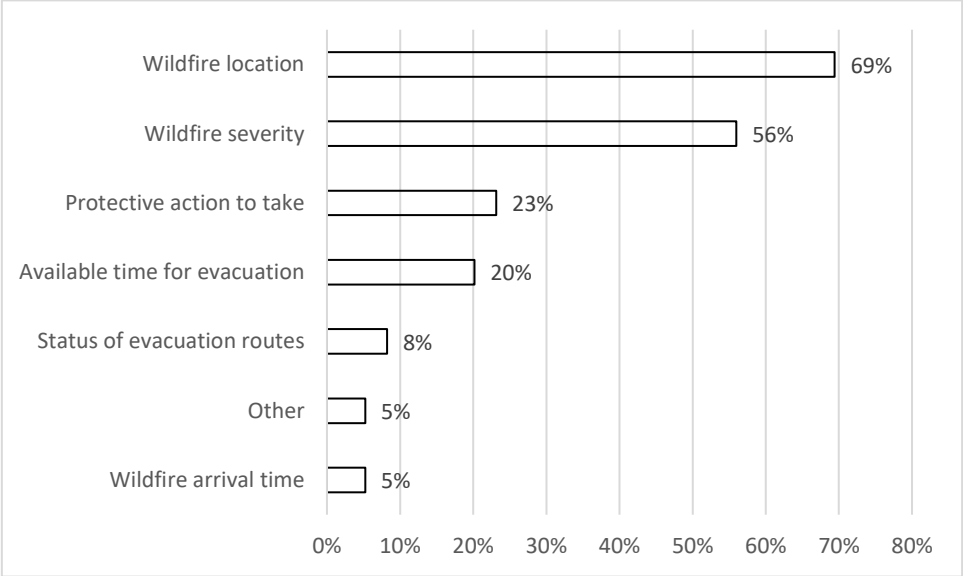


Figure 4.6 – Content of the first warning received (n = 134)

Respondents were asked about how they received the warning and the source of the warning. The questions were:

How was this first warning communicated to you?

Still thinking about that first warning, who was that warning from?

In terms of channels used for communicating the first warning (see Figure 4.7), many respondents reported that they received the first warning *"face-to-face"* (35%) and by *"text message"* (25%). In addition, *"internet and social media"* (16%) were also named as one of the main channels. The traditional media *"television"* (7%) and *"radio"* (7%) played only a minor role in receiving the first warning, according to the respondents. Figure 4.8 indicates that the primary sources for the first warning were identified by the respondents as *"civil defence"* (31%), *"neighbour or friend"* (26%) and *"family or relative"* (20%).

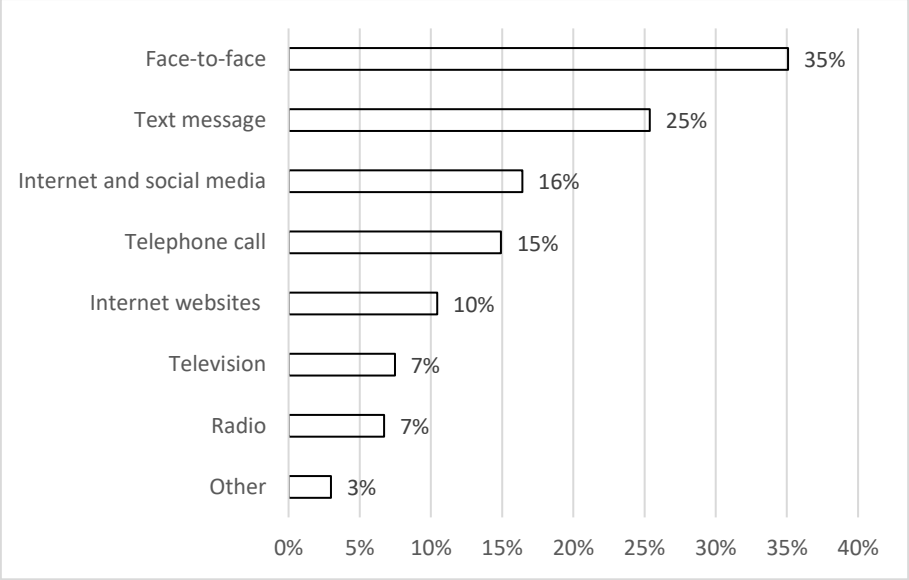


Figure 4.7 – Channel used to communicate the first warning (n = 134)

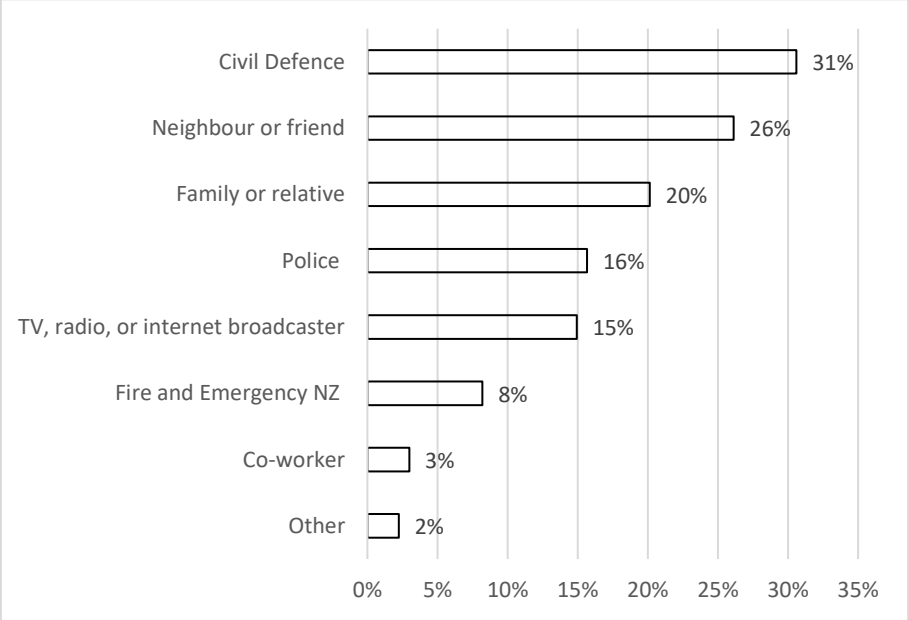


Figure 4.8 – Source of the first warning (n = 134)

The study explored respondents' beliefs and expectations of possible negative impacts of wildfire on them and their community after receiving the first warning. The questions were:

After receiving the first warning, how much would you say you believed each of the following things on a scale of 1 to 5 where one represents "did not believe" and 5 represents "fully believed"?

- *The fire would spread to my neighbourhood*
- *My neighbourhood would be damaged/destroyed by fire*
- *My home would be damaged/destroyed by fire*

After receiving the first warning, how much would you say you agreed with each of the following things on a scale of 1 to 5 where one represents "not likely", and five represents "extremely likely"?

- *I might become injured*
- *Other people/pets/livestock might become injured*
- *I might die*

- *Other people/pets/livestock might die*

Figure 4.9 illustrates that the average scope for rural areas regarding the possibility that fire might reach their neighbourhood is 3.7. However, the respondents were less inclined to believe that fire would destroy their neighbourhood (average scope of 3.2) or home (average scope of 2.9). Figure 4.9 also shows that the average scope for urban areas regarding the possibility that fire might reach their neighbourhood is 2.5. However, the respondents were less inclined to believe that fire would destroy their neighbourhood (average scope of 2.0) or home (average scope of 2.0). The average of the three estimates is shown in Figure 4.9.

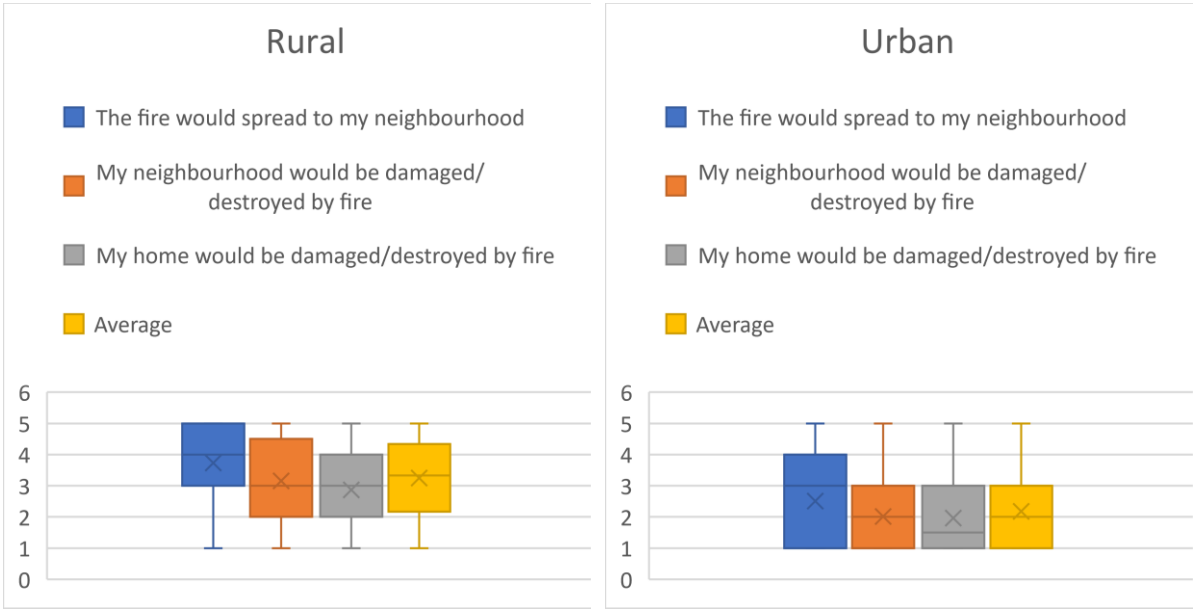


Figure 4.9 – Estimation of possible negative impacts due to the wildfire after receiving the first warning

As can be seen in Figure 4.10, many respondents from both regions believed that others (people, pets and livestock) might become injured or even die, but also that the spread of estimates is wide. The average of the three estimates is shown in Figure 4.10.

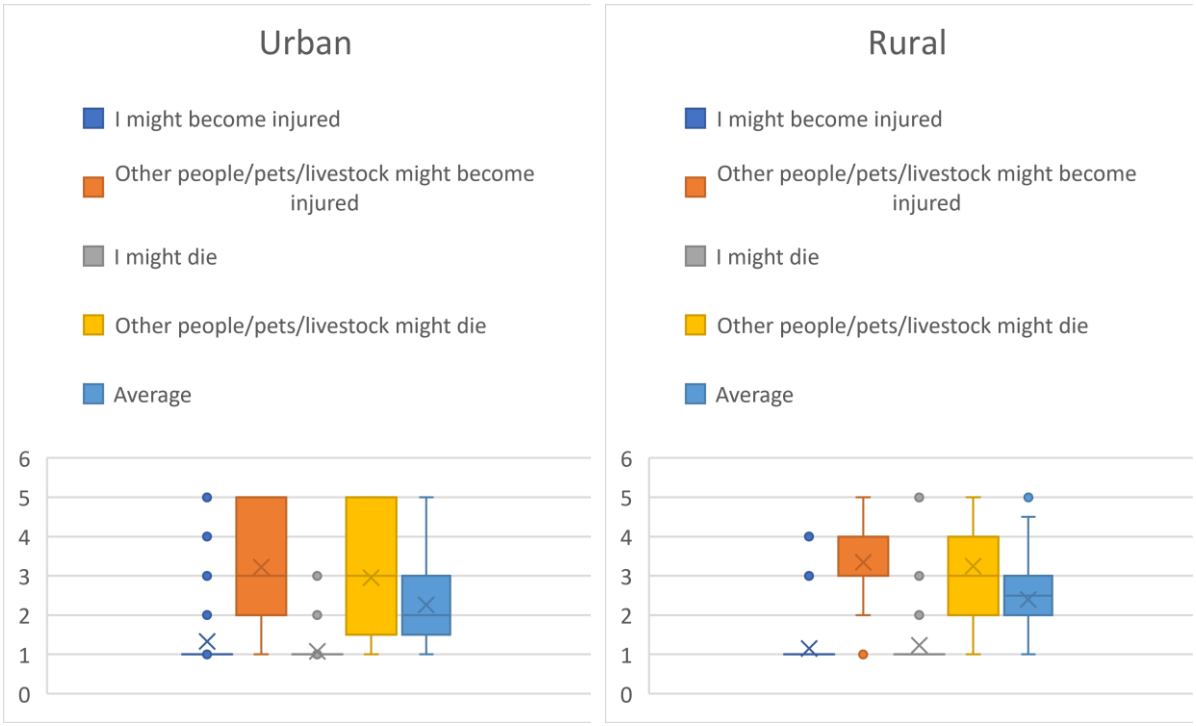


Figure 4.10 – Estimation of possible negative impacts due to the wildfire after receiving the first warning

The immediate reactions of the respondents to the first warning were also explored using the following question:

What was your immediate reaction to the first warning?

Figure 4.11 indicates that many people from the urban area "started preparing to act, and then waited for further information" (41%) or "tried to find more information" (24%). Many of the respondents from the rural areas also "started preparing to act, and then waited for further information" (28%) or "acted immediately" (33%). A Chi-Square test (X^2 (4, N = 134) = 15.481, p = 0.004) indicated a significant difference in immediate reaction to the first warning between urban and rural responses.

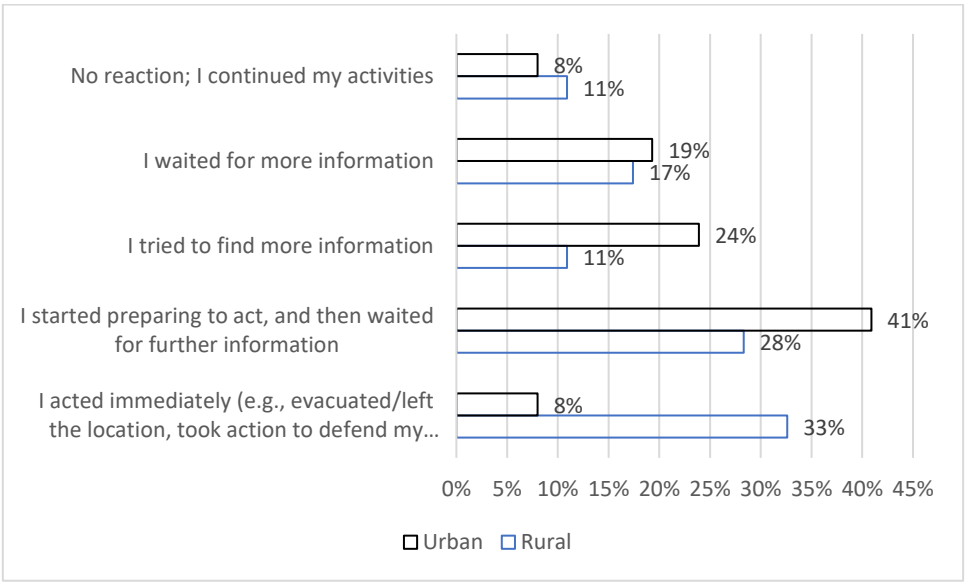


Figure 4.11 – Immediate reactions to the first warning (urban n = 88, rural n = 46)

4.3 Additional warning and fire cues

This section reports the results of the 66% of the households (n = 101) who reported to have received any additional warnings about a wildfire that could threaten their area. The respondents were asked the following questions:

How would you characterise these additional warnings?

What was the content of the additional warnings?

Who were these additional warnings from?

How did you receive these additional warnings?

Figure 4.12 shows that if the respondents had received additional warnings, the type of those warnings was mainly classified as *"information only"* (50%) or an *"official (or mandatory) order to prepare to evacuate"* (45%). As shown in Figure 4.13, the main content of those additional warnings was information about *"wildfire severity"* (76%) and *"wildfire location"* (73%).

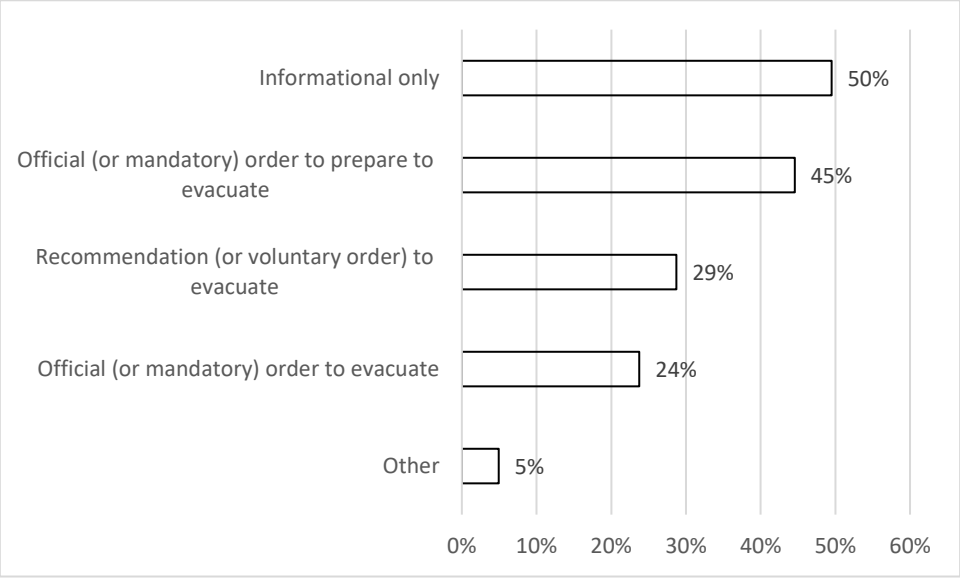


Figure 4.12 – Type of additional warnings (n = 101)

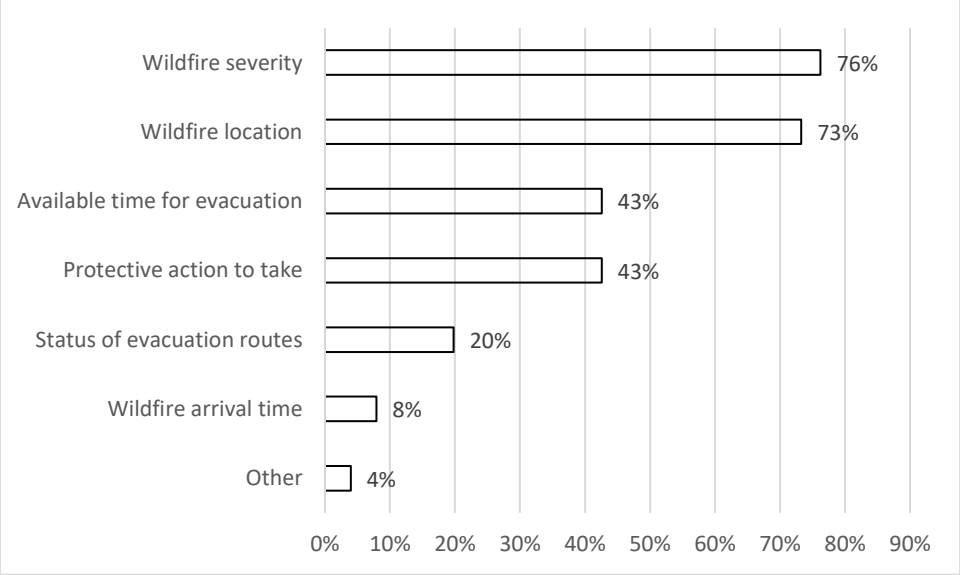


Figure 4.13 – Content of additional warnings (n = 101)

Figure 4.14 illustrates that most of the respondents received their additional warnings from either *"civil defence"* (51%), *"neighbour or friends"* (43%) or *"TV, radio, or internet broadcaster"* (39%). Figure 4.15 shows those additional warnings were mainly transmitted by *"face-to-face"* (48%), *"text message"* (43%) or "*Internet and social media"* (35%).

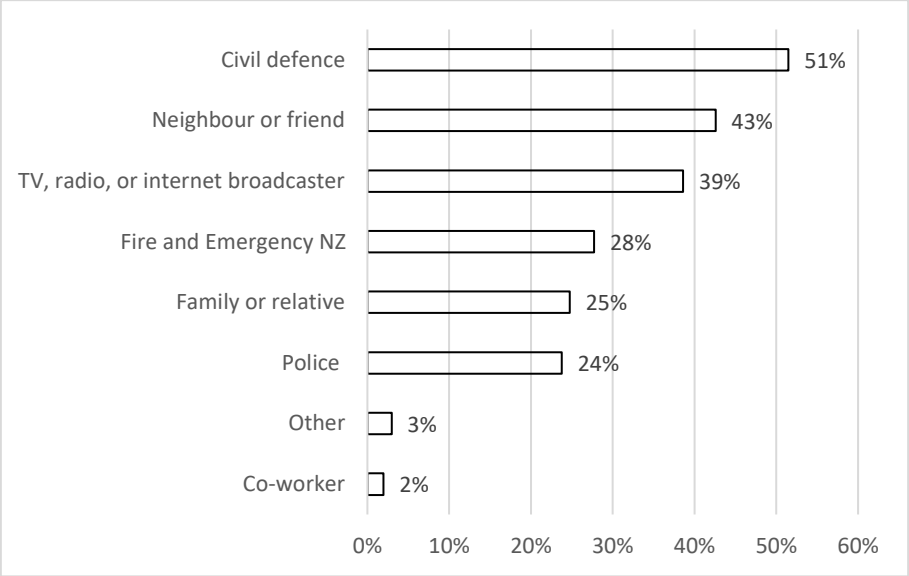


Figure 4.14 – Source of additional warning (n = 101)

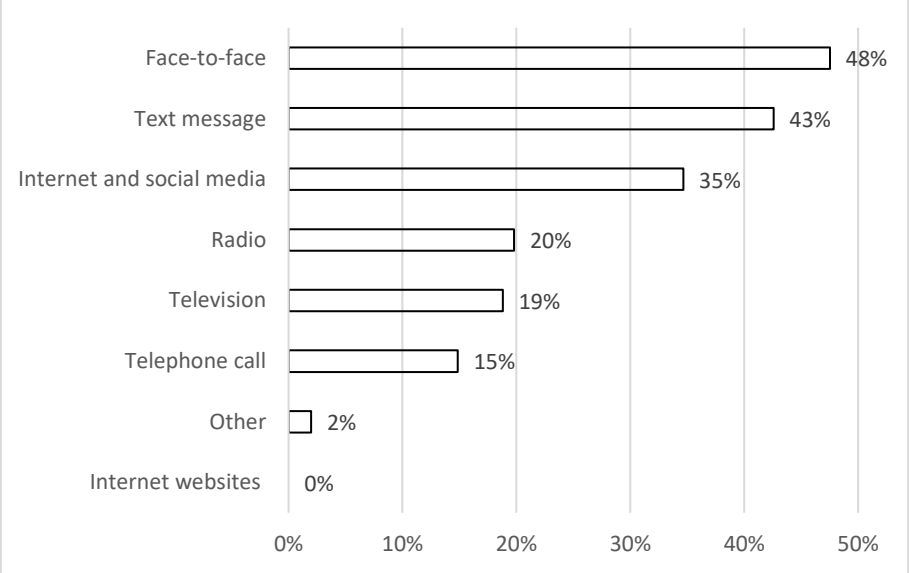


Figure 4.15 – Channel used to communicate additional warnings (n = 101)

The full sample was asked about the total number of official warnings they received before they made the decision either to evacuate or stay. The respondents were also asked to identify the most credible source of information when it comes to wildfire events. The questions were:

Before you either began your evacuation or decided not to evacuate, how many total warnings did you receive about the Pigeon Valley Fire that you would classify as official or mandatory evacuation warnings?

Who do you consider the most credible source of information about wildfire events?

As Figure 4.16 demonstrates, 30% of respondents from the rural areas did not receive a single official or mandatory evacuation warning. In comparison, only 13% of respondents from the urban area stated that they did not receive any official or mandatory evacuation warnings. Twenty per

cent of people from the rural areas and 22% of respondents from the urban area received at least one official evacuation warning. However, 24% of respondents from the urban area received two warnings which they classified as mandatory or official. A Chi-Square test indicated that there is an association between type of areas and the number of warnings (X^2 (6, N = 152) = 28.873, p = 0.000).

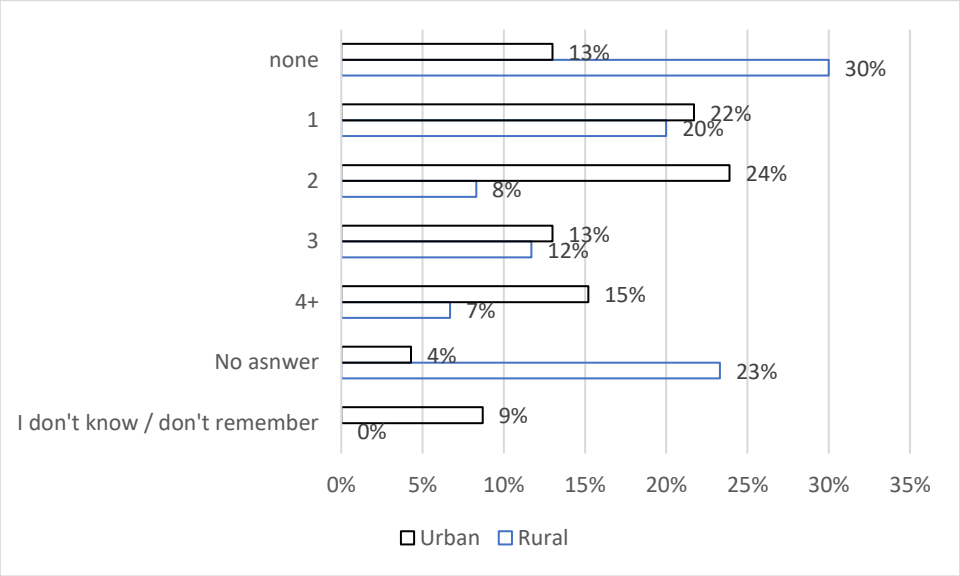


Figure 4.16– Total number of warnings received which were classified as an official or mandatory evacuation warning (urban n = 92, rural n = 60)

Figure 4.17 shows that the majority of the respondents (60%) from the urban area indicated *"Civil Defence"* as the most credible source, followed by *"Fire Service"* (28%). The respondents from the rural areas named three sources nearly equally; *"Civil Defence"* (33%), *"Police"* (30%) and *"Fire service"* (28%).

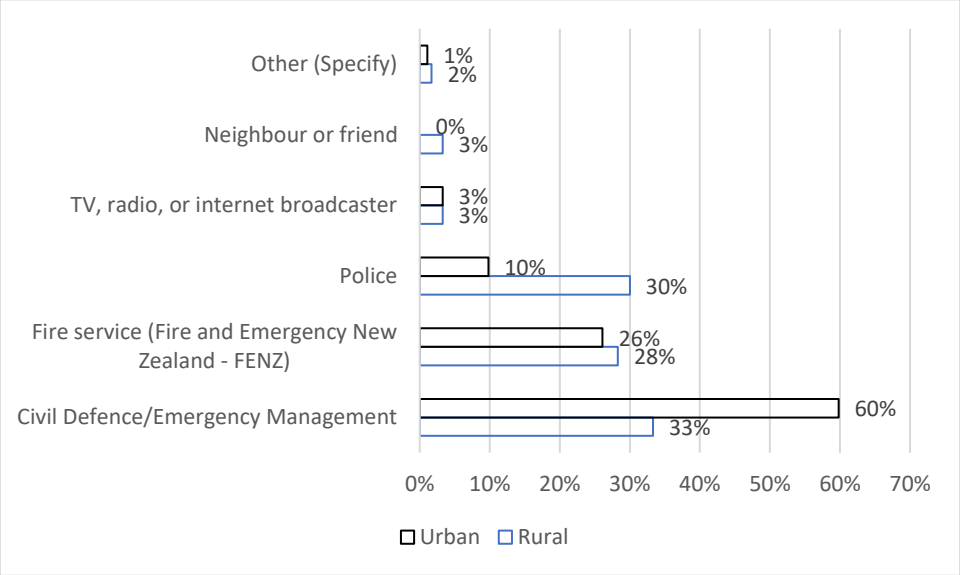


Figure 4.17 – The most credible source of information about wildfire events (urban n = 92, rural n = 60)

The respondents were asked if they perceived any fire cues (e.g. flames, smoke, embers, smell, etc.) before they made the decision either to evacuate or stay. The question was:

Before you either began your evacuation or decided not to evacuate, did you perceive any fire cues from the Pigeon Valley Fire, e.g., seeing, hearing, feeling, or smelling the fire (e.g. flames, smoke, embers, smell, etc.)?

Table 4.4 indicates that nearly all respondents (98%) perceived fire cues (seeing, hearing, feeling or smelling the fire). As can be seen in Figure 4.18, respondents mentioned: *"see smoke"* (97%) and *"smell smoke"* (76%) most often. Slightly more than half of the respondents had experienced *"flames"* and *"embers"*. Only 8% were able to feel the actual heat from the fire.

Table 4.4 – Fire cues perceived

Response	Rural	Urban	Total
No	2 (3%)	1 (1%)	3 (2%)
Yes	58 (97%)	91 (99%)	149 (98%)

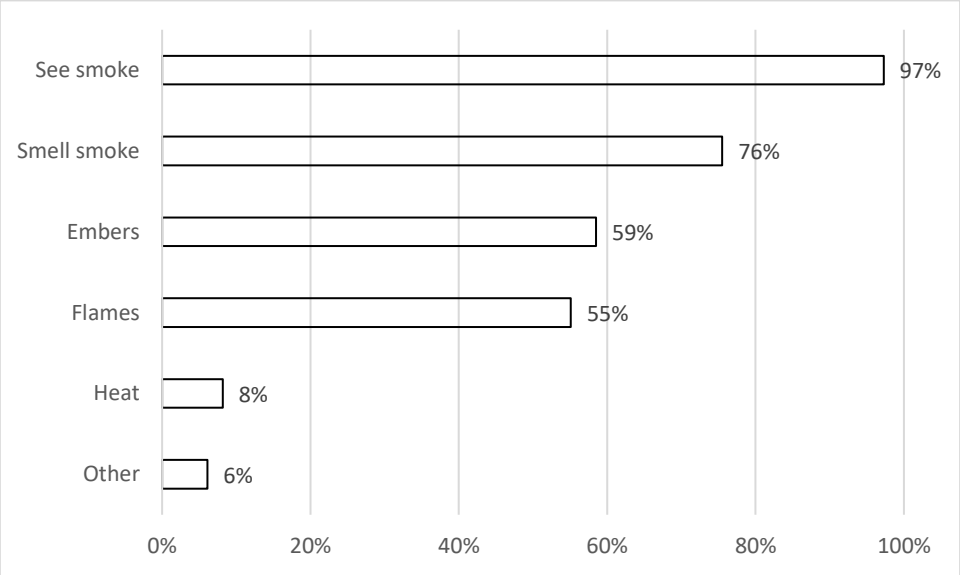


Figure 4.18 – Types of fire cues perceived (n = 147)

The study explored what respondents believed and expected after receiving the fire cues of the possible negative impacts the wildfire might have on them and their community. The questions were:

After receiving those fire cues, how much would you say you believed each of the following things on a scale of 1 to 5 where one represents "did not believe" and 5 represents "fully believed"?

- *The fire would spread to my neighbourhood*
- *My neighbourhood would be damaged/destroyed by fire*
- *My home would be damaged/destroyed by fire*

After receiving those fire cues, how much would you say you agreed with each of the following things on a scale of 1 to 5 where one represents "not likely" and five represents "extremely likely"?

- *I might become injured*
- *Other people/pets/livestock might become injured*
- *I might die*
- *Other people/pets/livestock might die*

Figure 4.19 illustrates that the average scope for rural areas regarding the possibility that fire might reach their neighbourhood is 3.5. However, the respondents were less inclined to believe that fire would destroy their neighbourhood (average scope of 3.1) or home (average scope of 2.9). Figure 4.19 also shows that the average scope for rural areas regarding the possibility that fire might reach their neighbourhood is 2.6. However, the respondents were less inclined to believe that fire would destroy their neighbourhood (average scope of 2.3) or home (average scope of 2.1). The average of the three estimates is shown in Figure 4.19.

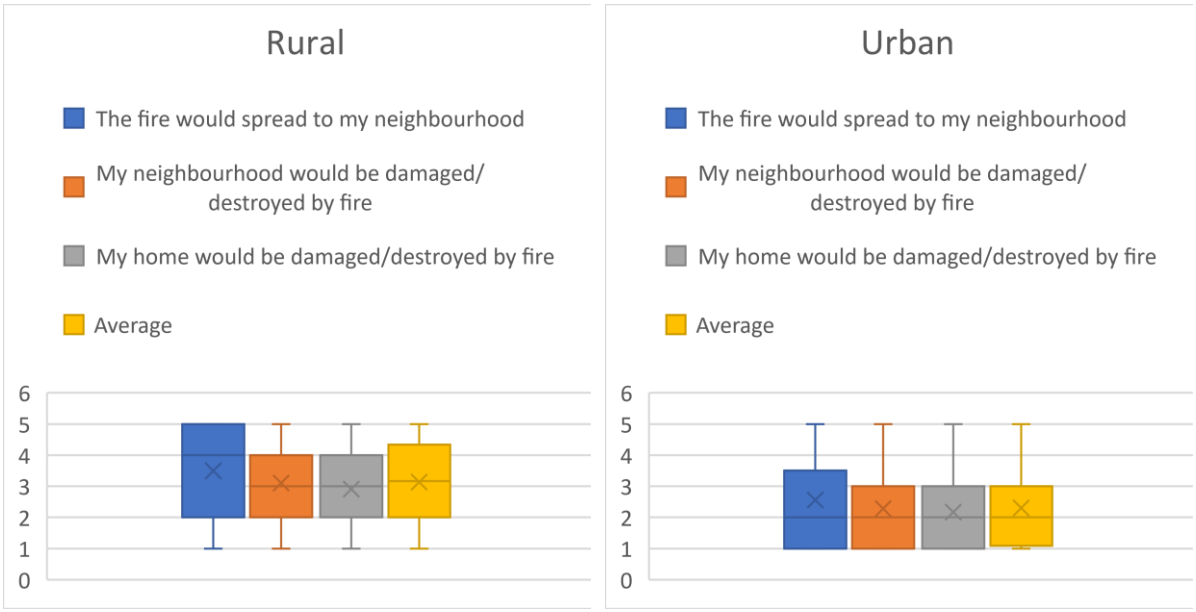


Figure 4.19 – Estimation of possible negative impacts due to the wildfire after receiving the fire cues

As can be seen in Figure 4.20, a number of the respondents from both areas stated that others (people, pets and livestock) might become injured or even die due to the wildfire. However, very few of the respondents from both areas believed they would become injured or would die.

Figure 4.20 – Estimation of possible negative impacts due to the wildfire after receiving the fire cues

The immediate reactions by the respondents to the fire cues was explored using the following question:

What was your immediate reaction to these fire cues?

Many of the respondents from both areas (urban 40%, rural 33%) started to prepare to act and waited for further information. A greater number also sought information, whereas this option was more often stated by respondents from the urban area (29%) compared to people from rural

areas (17%). Besides, several respondents (21%) from the rural areas acted immediately after having received the first fire cues. This was only perceived as necessary by 8% of people from the urban area. Nevertheless, some respondents from both areas (urban 8%, rural 14%) stated that the received fire cues had not triggered any reaction at all. A Chi-Square test was not able to indicate an association between the type of areas and the reaction (X^2 (4, N = 147) = 8.106, p = 0.088).

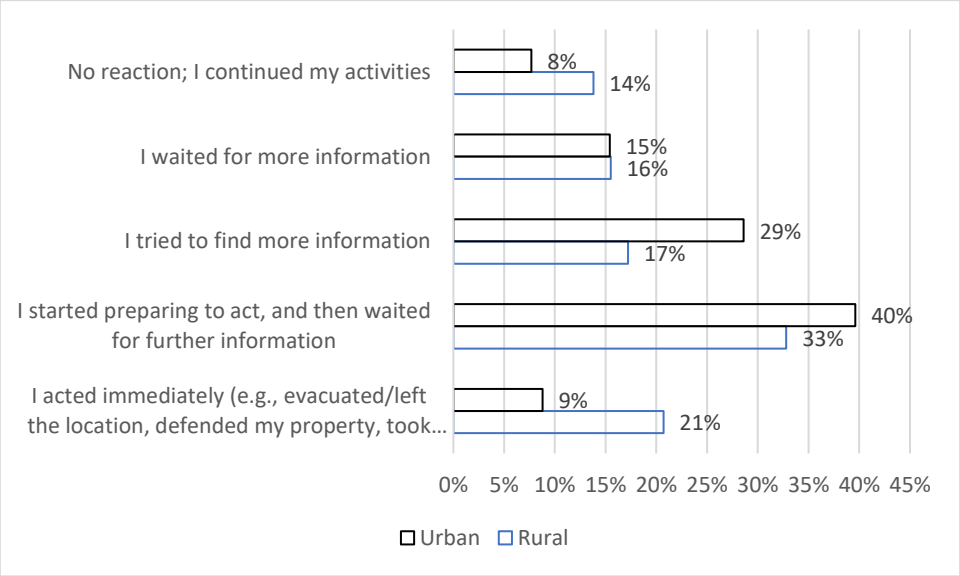


Figure 4.21 – Immediate reaction to fire cues (urban n = 91, rural n = 58)

4.4 Response

This section reports the results on household response to the Pigeon Valley Fire. Respondents were asked whether they decided to evacuate or stay and when they took the decision to evacuate (if they decided to do so) by using the following questions:

In response to the Pigeon Valley Fire, what did you decide to do?

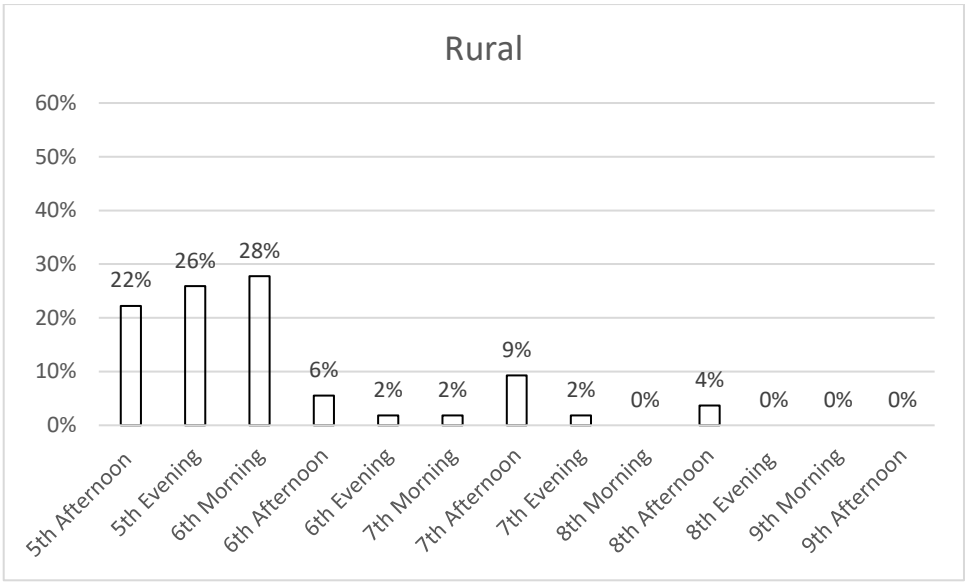
When did you take the decision to evacuate?

As shown in Table 4.5, the vast majority of the respondents (96%) decided to leave their home and evacuate in response to the wildfire. Figure 4.22 illustrates that the majority of households from the rural areas decided to leave their home on the first or second day after the fire broke out (see official timeline in Chapter 2). Respondents from the urban area decided to evacuate five days after the fire started. In total, only 6 of the 152 households (4%) decided to stay in spite of the evacuation order.

The data are very unequally distributed among participants who decide to evacuate or stay, and Fisher's exact test was therefore used. The test has a p-value of 0.213 (>0.05), and no significant difference can therefore be proven between the decision taken for households in urban and rural areas.

Table 4.5 – Decision to evacuate or stay

Response	Rural	Urban	Total
I decided to evacuate	56 (93%)	90 (98%)	146 (96%)
I decided to stay in place	4 (7%)	2 (2%)	6 (4%)



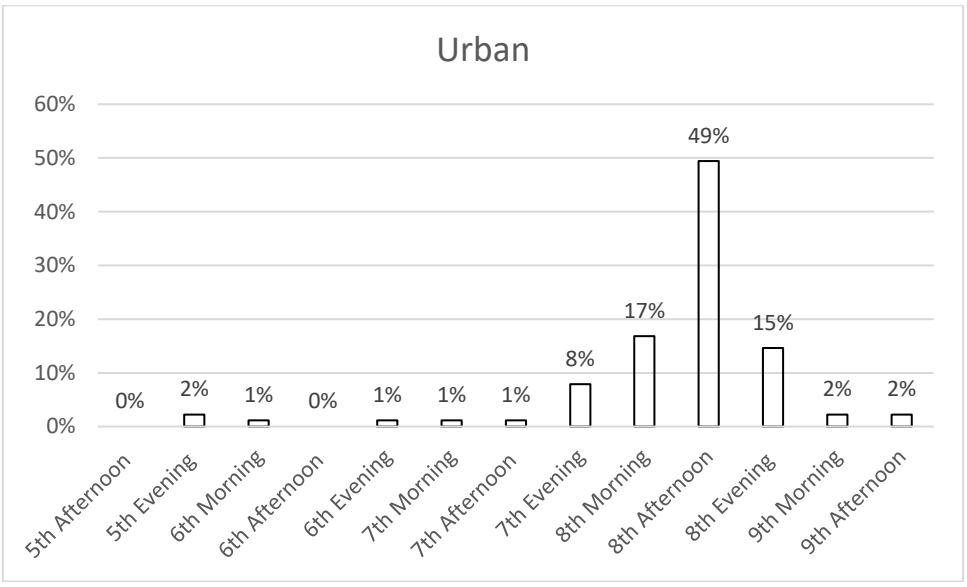


Figure 4.22 – Date/time when the decision was made to evacuate in rural areas (n = 54) and urban areas (n = 89).

The study investigated what respondents believed and expected after deciding to evacuate in terms of possible negative impacts the wildfire might have on them and their community. The questions were:

At that moment you decided to evacuate, how much would you say you agreed with each of the following things on a scale of 1 to 5 where one represents "not likely", and five represents "extremely likely"?

- *I might become injured*
- *Other people/pets/livestock might become injured*
- *I might die*
- *Other people/pets/livestock might die*

Figure 4.23 shows that the respondents from both areas did not, on average, believe that they might become injured or even might die at the moment they decided to evacuate. In contrast, the respondents, on average, believed that others (people, pet and livestock) might become injured or die.

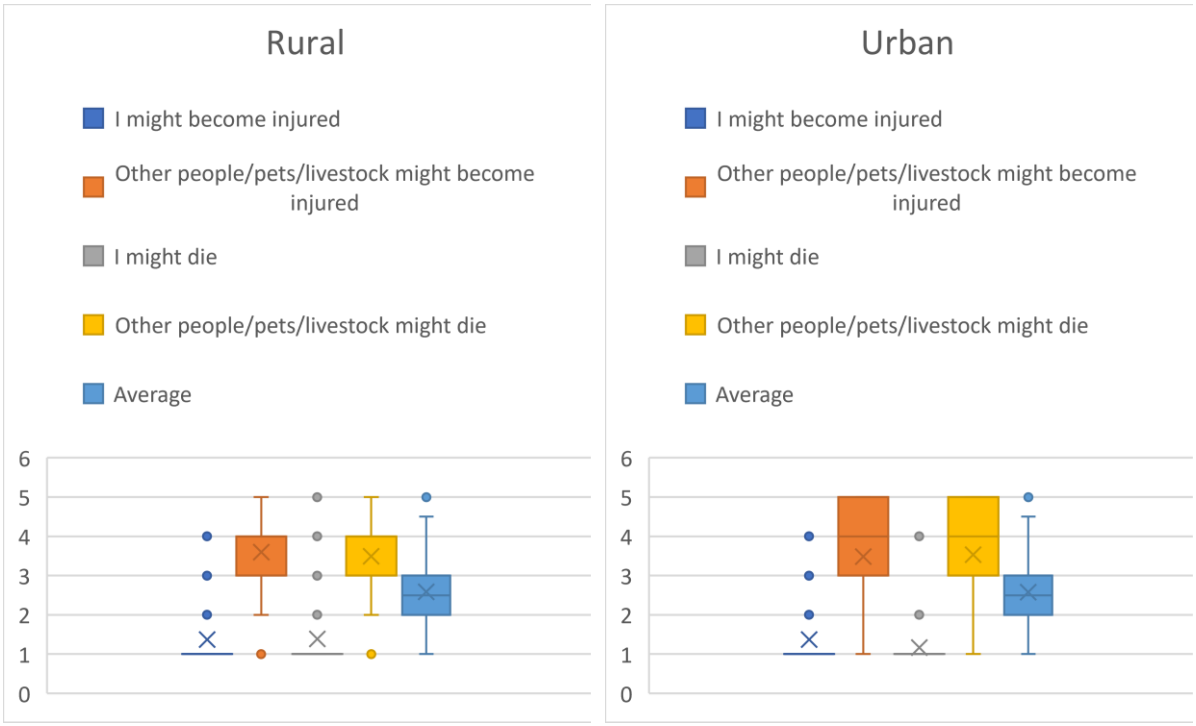


Figure 4.23 – Estimation of possible negative impacts due to the wildfire in the moment of deciding to evacuate

The average scores for negative impact on themselves, people and animals at different stages (i.e. first warning, fire cues and decision) are compared for urban and rural areas in Figure 4.24. Although there is some variation, the average perceived risk changes very little from perception of the first warning until the decision to evacuate or stay in place.

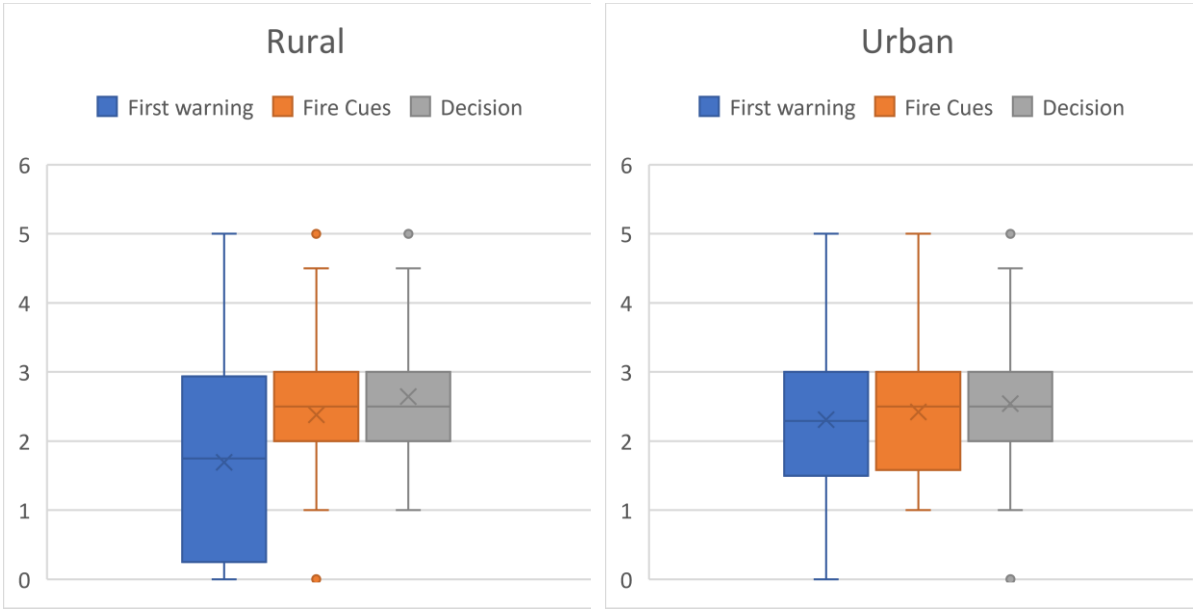


Figure 4.24 – Estimation of possible negative impacts on themselves, people and animals due to the wildfire in the moment of deciding to evacuate

Several questions were asked to explore how and why households made the decision to evacuate and how long it took to leave after they decided to do so. The question was:

Which of the following best describes how you made the decision to evacuate?

How long did it take to leave/evacuate after you took the decision to do so?

What were the main reasons that you eventually left/evacuated?

Between the time you received your first warning or fire cue and the time you evacuated, did you do any of the following before leaving?

Figure 4.25 indicates two major scenarios for how the decision was made. Over 50% of the households followed the instructions by an authority (i.e. official warnings), and approximately 30% made the decision together as a family. Figure 4.26 illustrates that most of the respondents from both urban and rural areas reported similar pre-evacuation times after they decided to leave. So, the pre-evacuation was between 30 and 120 minutes for 50% of all respondents regardless of the area.

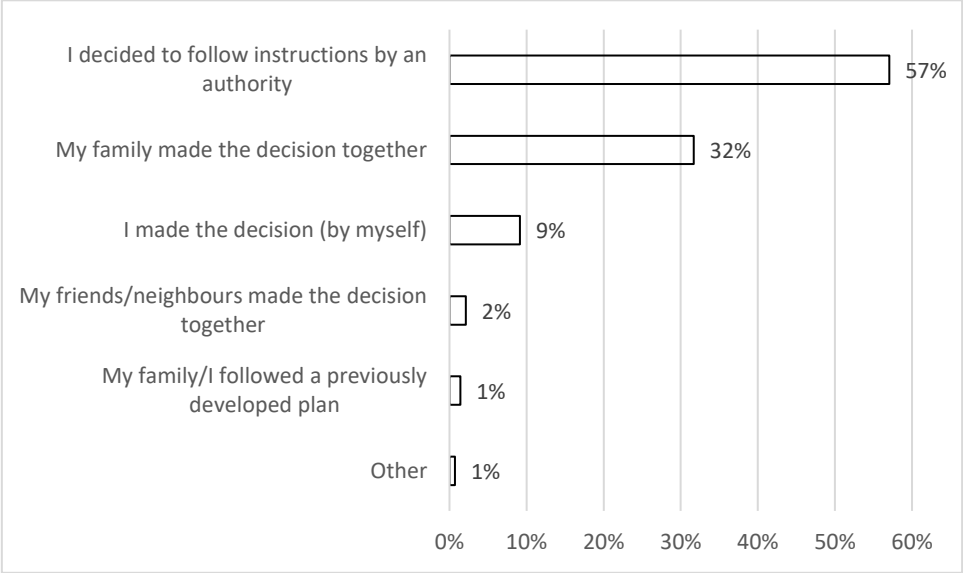


Figure 4.25 – Decision process to evacuate (n = 146)

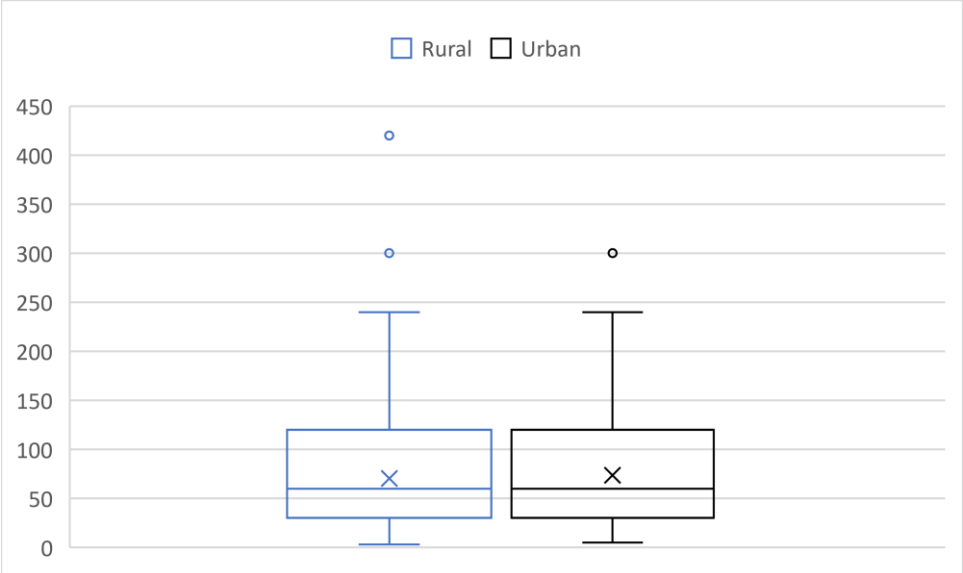


Figure 4.26 – Pre-evacuation time in Min after the decision to leave was taken

Figure 4.27 shows that over 50% of all households evacuated because they were told to do so by emergency officials. Also, receiving fire cues was the main trigger for the decision to leave their homes for almost half of all households that evacuated. Another reason was the information about the fire (25%) or that the respondents were afraid and felt danger for their family/friends (23%).

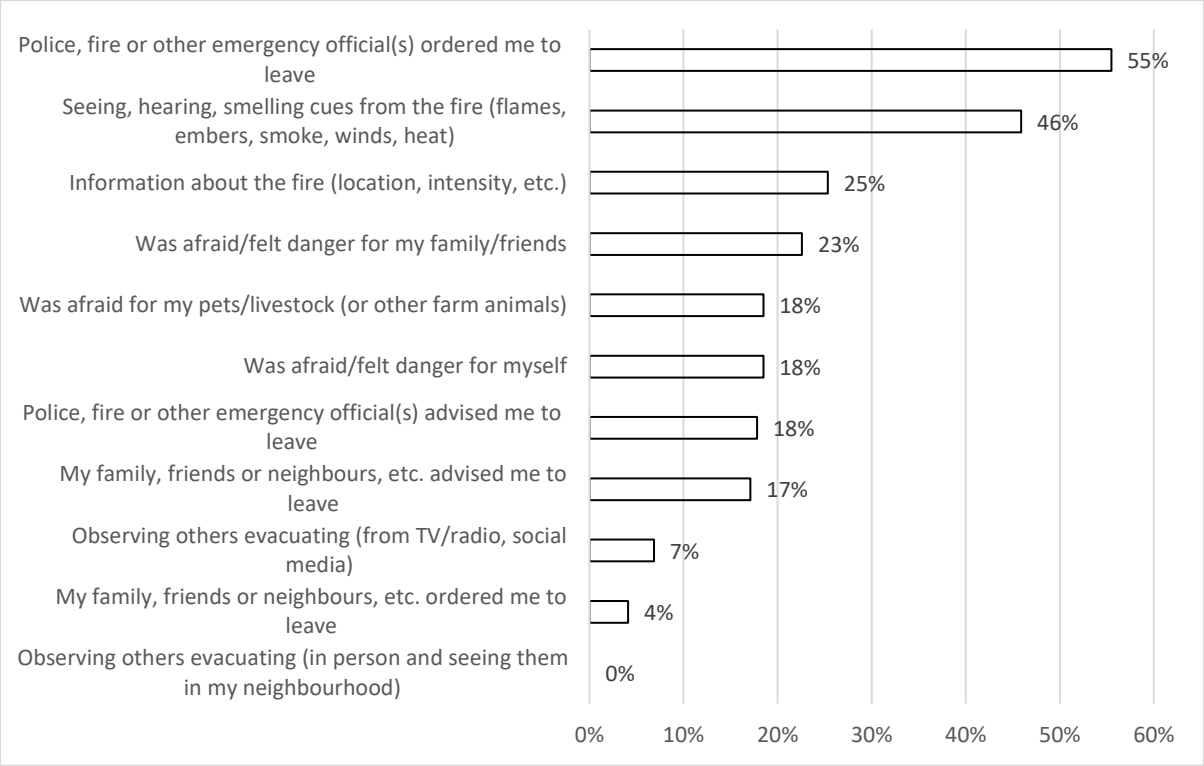


Figure 4.27 – Main reason for the evacuation (n = 146)

As shown in Figure 4.28, the study also identified actions taken between the time of receiving the first fire cues/warnings and eventually leaving home. The vast majority of the evacuated households packed their belongings and loaded the vehicle (92%) as well as secured their homes (84%). Around 50% of all households performed preparatory actions. Finally, the data indicates the average number of actions was 5.4 with a standard deviation of 3.0.

Six households (4%) stated that they decided to stay in place, namely four in the rural areas and two in the urban area. Respondents who stated that they did not evacuate were asked why they decided to do so, using the following question:

If you did not evacuate, why didn't you leave?

Five out of the six answered this question (multiple answers were possible). Three respondents stated that they decided to stay to protect (or defend) their property, two to do their job, one to take care of pets/livestock (or other farm animals), and one did not believe their area/property was at risk.

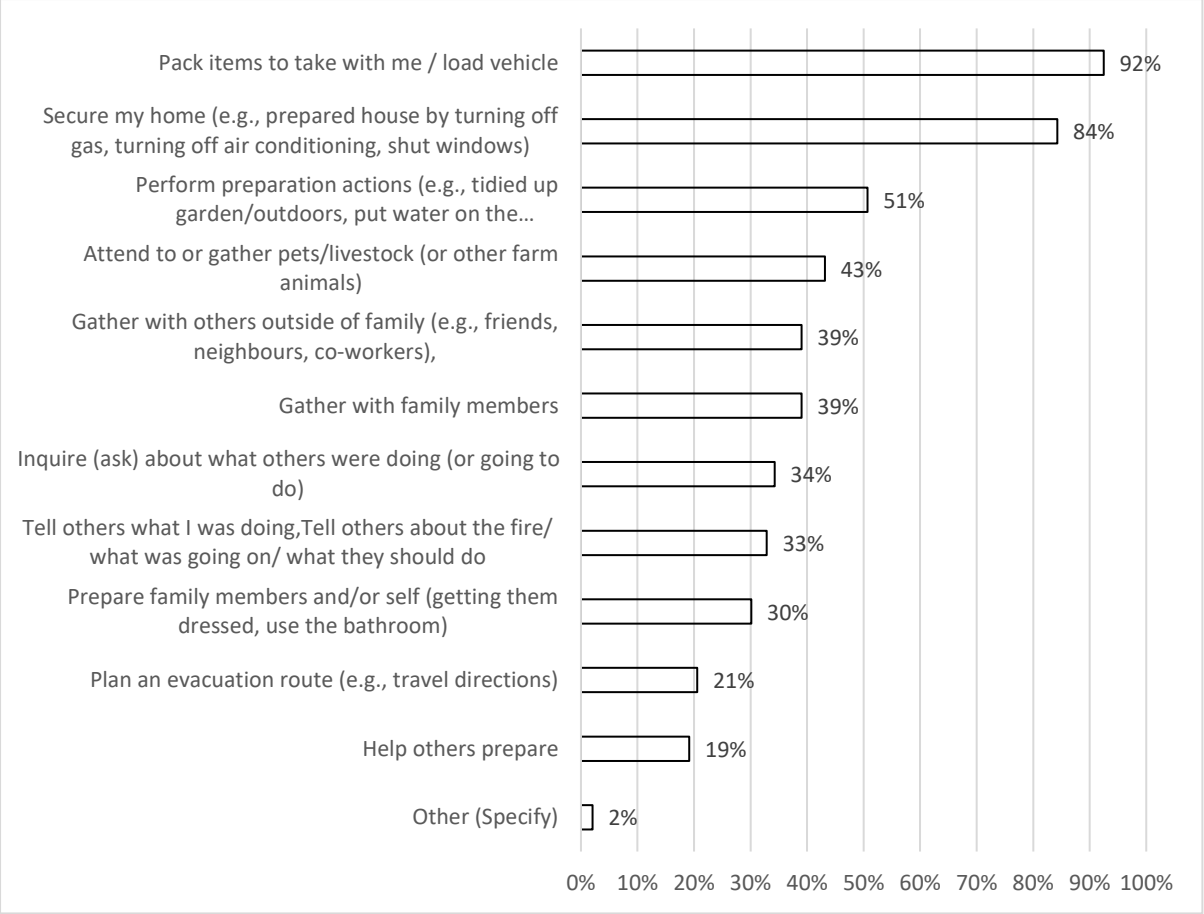


Figure 4.28 – Action taken between fire cues/warnings received and actual evacuation (n = 146)

4.5 Open comments

Of the 152 complete responses to the survey, 99 individuals (65%) shared an optional end-of-survey comment (the content was not directed or restricted in any way). A thematic analysis method (Braun & Clarke, 2006) was used to summarise and describe the central concepts shared in these comments, which will be described briefly below.

To begin, respondent comments were read repeatedly by two team members, and a list of initial codes (i.e., all topics raised by participants) was developed. A high prevalence of comments was focused on post-evacuation recovery rather than the evacuation or was more general in nature, in that they did not specify a particular process on which they were commenting. While these topics were not the focus of the survey described in this report, they were topics many participants wanted to discuss and may provide valuable insight for emergency management officials. As a result, codes were separated into three main areas: evacuation, post-evacuation/recovery, and general comments. The first area contained topics relevant to the focus of the survey effort – namely, pre-evacuation factors such as awareness of risks, as well as perceptions of evacuation communication, fire-fighting efforts, and the evacuation process itself. The second area contained concepts related to post-evacuation and recovery, including support from officials and the community, re-entry, and compensation. Third, general comments about information, management, and expressions of gratitude were categorised separately because they did not specify whether they referred to evacuation-related or post-evacuation experiences.

Following the creation of initial codes and a corresponding codebook, all 99 comments were coded by one team member. The results of this coding effort were reviewed by both team members and then grouped into several main themes within each of the three main content areas (i.e. evacuation,

recovery, and general comments). Over the course of several iterative sessions, these themes, their associated codes, and the codebook were further refined until the final versions of each were developed. Namely, that themes were coherent, clearly distinguishable, and captured the majority of concepts raised by participants. (see Braun and Clarke (2006) for more details on the thematic analysis methodology).

4.5.1 Pre-evacuation and Evacuation Comments

A total of 45 respondents contributed comments related to pre-evacuation factors and the evacuation process itself. Five main themes emerged: discussion of evacuation communication, the evacuation process, the necessity of the evacuation, how prepared the community was for the evacuation and comments on firefighting efforts.

Theme 1: Communication during the evacuation

Several comments in this area (n = 17) were related to communication, and namely, the evacuation alerts, warnings, and notices used to inform the public during the evacuation process. Of these, some participants (n = 6) indicated that they found the evacuation communication to be helpful and informative, stating that: *"…the police and the civil defence did an amazing job letting us know what was happening"*, and *"as resident[s] we were […] given solid, verified reasons for our evacuation"*.

However, others (n = 9) felt that the evacuation communication they received was insufficient for a number of reasons, most commonly that they did not receive any warnings (n = 5); an issue that was mainly attributed to technological issues (i.e., not having a compatible smartphone or not having a cell phone). Others (n = 7) felt that communication did not provide sufficiently detailed information about fire conditions or was critical of the failure to assess the high fire risk level in advance or alert local farmers to take additional precautions on the day of the fire.

Theme 2: The evacuation process

Another theme within evacuation-related comments was experiences with and opinions about the evacuation process itself (n = 20). Several respondents reported that they felt stressed or disturbed by the process (n = 6), stating that it was a *"scary"* and *"harrowing"* time. Some of this fear was attributed to the rushed nature of the evacuation. On the other hand, respondents stated that the process was generally well-managed and *"brilliantly done"* by authorities (n = 8), such as: *"The Police were excellent during our forced evacuation"*, and the *"…evacuation process and organisation was managed very well"*. Some participants (n = 5) also shared some specific issues they experienced with the evacuation process, including difficulty evacuating their animals, a lack of physical assistance for ill and disabled evacuees, and evacuation routes being blocked by curious members of the public.

Theme 3: Need for evacuation

Some respondents also expressed that they felt the evacuation was not necessary or infringed on property owners' rights (n = 6). Of these, some felt forced to evacuate and expressed their belief that *"…residents should have the option to defend their property if reasonable"* and have greater autonomy in their evacuation decision. Others felt as though the evacuation was an *"overreaction"* based on their perception that the fire risk was low at their specific location.

Theme 4: Evacuation preparation

A few comments pertained to a general lack of evacuation preparation present within the community (n = 5), suggesting that the majority of evacuees did not have an emergency plan, including an evacuation destination, and were not generally prepared to evacuate. Those who felt they were prepared observed that many of their neighbours were not aware of fire risks, were not

prepared to evacuate, or were seemingly too *"laid back"* after receiving official warnings, perhaps because they were unaware of the danger.

Theme 5: Firefighting efforts

Lastly, a proportion of comments related to firefighting efforts and fire prevention (n = 10). Overall, respondents expressed that *"thanks are not enough"* for firefighters' efforts. One wrote that *"the way the [they] contained the fires [was] outstanding"*, and one participant expressed that while they were scared during the evacuation, they were reassured by the presence of police and military personnel and the efforts of firefighters to protect their properties. However, a small proportion of respondents were critical of how long it took to bring in firefighting equipment (n = 2).

4.5.2 Post-evacuation and Recovery Comments

A total of 40 individuals shared comments on their post-evacuation and recovery experiences. Five themes emerged, which included discussions of post-fire coordination and recovery by authorities or Non-Governmental Organisations (NGOs), support or resilience that came from within the community, issues with re-entry, compensation, and caring for livestock.

Theme 1: Post-fire coordination and recovery by authorities and NGOs

Twenty-one respondents commented on recovery efforts made by authorities and NGOs, including volunteers. A large proportion of these respondents (n = 14) expressed that they felt recovery efforts were well-managed by authorities and that the *"Level of support was outstanding"*. Generally, comments under this theme expressed thankfulness for the support and information they received from what they perceived to be a well-organised recovery effort. A few of these comments also specifically addressed efforts to protect properties, and stated that they were *"thankful for police, army, Red Cross, personal [sic] that patrolled our properties while we were evacuated"*.

Some participants reported negative experiences with the recovery process (n = 8), primarily focused on issues with food donation and distribution. One respondent stated that *"there was a lot of confusion around whether food prepare[d] in private homes could be accepted at the CD [Civil Defence] centre. This meant people were turned away, causing a lot of distress among already [sic] stressed people."*. Also related to the food issue, some of these individuals felt that food distribution should have been better regulated by requiring proof of identity or keeping track of who had already accepted food. Less common negative experiences were related to inconvenient meeting times, lack of access to medication after local pharmacies closed, and difficulties for those living on the edge of evacuation zones with access to food, fuel, and information.

Theme 2: Support or resilience from within the community

Respondents (n = 6) also shared that a general sense of support or resilience from within the community aided in their post-fire recovery. The overall sentiment was that *"…the community responded very well"*, which was demonstrated by *"friends and neighbours knock[ing] on doors and offer[ing] help"* and *"the support shown by local businesses and unaffected residents"*.

Theme 3: Re-entry

Some respondents shared that they experienced specific issues with the re-entry process (n = 13). Of these, some participants felt there was a lack of information about re-entry, specifically not knowing when they would be able to return to their properties and complications with the registration process. One respondent *"Had to register seven times in the first view [few] days for returning home"*, and others indicated that they never received information about re-entry after registering or felt that record-keeping and information provided about re-entry was insufficient.

Other participants expressed that the evacuation period was longer than they felt it needed to be (n = 5), stating that the *"evacuation period of two weeks was to [sic] long"* and that *"Cordons and allocated times to visit were unreasonable"*. One of these individuals felt that re-entry could have been allowed sooner if residents were given more authority to put out flare-ups.

Theme 4: Compensation

A few participants noted issues with receiving compensation for damages caused by the fire (n = 5). Of these, there were complaints related to insufficient compensation provided by authorities or issues with receiving insurance compensation, including that insurance did not cover expenses such as evacuation accommodations or damage caused by fire protection machinery. Of these comments, only one reflected that the participant did receive financial assistance, but they still noted that *"damage compensation [was] only 50% of the claimed value"*.

Theme 5: Livestock management

Lastly, comments related to post-evacuation recovery included issues with caring for livestock, specifically (n = 7). Related to general comments about re-entry issues and the length of the evacuation period, one respondent noted that it was stressful being away from home for three weeks, unable to access their property and care for their animals. Some of these individuals also stated that they experienced issues with their livestock after fences were destroyed when firebreaks were put in, allowing the livestock to wander and intermix with animals belonging to neighbouring farms. One participant indicated that they were able to return to their property to take care of their livestock but wished they had been warned about broken fences so they could have been better prepared to address the issue.

4.5.3 General Comments

Lastly, a total of 45 respondents shared general thoughts and perceptions without specifying if they pertained to pre- or post-evacuation experiences. In this area, three main themes emerged: approval of management, gratitude towards authorities and volunteers, and information received.

Theme 1: Management

Many comments (n = 27) centred around management without clear reference to a specific part of the wildfire timeline. Almost all comments were positive, such as: *"Authorities did an amazing job"*, *"I felt the authorities managed this all very well"*, and "*the emergency organization was excellent"*.

Theme 2: Gratitude

Respondent comments (n = 8) also conveyed a general sense of gratitude or appreciation for authorities, expressing that they *"felt the local emergency services did everything possible to keep our community safe and we will be forever grateful"*, and are *"full of admiration for the Civil Defence people"*. Another said that they *"Just can't thank the emergency services enough for all the long hard hours they put in to save our community"*. Respondents thanked local emergency services, volunteers, Civil Defence, police, army, fire, and Red Cross personnel in these expressions of gratitude for their efforts, and specifically those who looked after their property and pets while they were evacuated.

Theme 3: Information

Additionally, participants (n = 15) provided general comments about the sufficiency of information or updates without specifying when this information was received or should have been provided. The majority of these comments were positive (n = 10), and expressed that *"Communication was excellent"*, *"…the info flow to the public was excellent"*, and *"we were kept well informed of the progress of the fire and [of] help that was available for us in community meetings and social media"*. Others

were thankful for information received from Civil Defence specifically: *"Civil defence website [was] highly useful to get updated information"*, and *"the civil defence alerts were extremely important and a vital source of getting information out quickly"*.

A smaller proportion of general comments related to information were critical (n = 5). Some of these felt the information provided was unorganised and uncoordinated between organisations, which made it *"Difficult to follow procedure and get information"*. Additionally, one respondent suggested that officials provide *"more information, not just on Facebook as many older people do not have [sic] this forum"*, and another stated that they only received information from firefighters and had to search for additional information themselves.

5. Discussion

This study aimed to investigate how households affected by the Pigeon Valley Fire perceived the wildfire threat and responded to it. By collecting data using a combined face-to-face and online questionnaire, it was possible to identify which warnings and fire cues were received by the households living in rural and urban areas, as well as the perceived risk. The data shows that authorities, such as Civil Defence, Fire and Emergency, and Police, played a key role in alerting households about the need for evacuation.

5.1 Preparedness

From a preparedness viewpoint, the data shows that relatively small percentages had taken measures (25%) and had plans (14%) to cope with wildfire. The lack of preparedness is also confirmed by some of the end-of-survey comments (see Section 4.5.1). The result shows that rural households were significantly more aware of the threat of wildfire than urban households (see Table 4.1 and Figure 4.1). The data identifies a statistical difference between urban and rural households for measures taken to protect property from wildfires (see Table 4.2), but no significant differences could be found for making plans to cope with future wildfire threat before the Pigeon Valley Fire (see Table 4.3).

The results suggest that the awareness of fire risks in wildfire-prone communities can be improved, which can lead to improved preparedness. One possible way to achieve this is to put more resources in place to inform households in wildfire-prone areas about the risks, as well as possible measures and plans required to mitigate the risk. It is believed that important lessons can be learned from communication strategies currently used for floods, earthquakes and tsunami.

5.2 Warnings and Fire Cues

In this report, warning refers to any information (official or unofficial) from the emergency services, media, or personal contacts such as friends, relatives or co-workers. The data indicate that wildfire warnings reached the households relatively fast, especially in the rural areas where the evacuation was required immediately (see Figure 4.4). The main information channels were face-to-face, text, internet and social media (see Figure 4.7). The main first source of information were authorities, such as Civil Defence, Fire and Emergency and Police, as well as friends, neighbours and family (see Figure 4.8). The data illustrates that after receiving the first warning, many of the respondents kept searching or waiting for further information (see Figure 4.11).

Of note is that 23% of the rural households did not acknowledge receiving any warnings classified as official or mandatory evacuation warnings (see Table 4.3). This result can be due to them evacuating because they saw the fire before the official warning was given to them. The end-of-survey comments (see Section 4.5.1) suggest that part of the issue of lack of warnings was related to technology, e.g., people not having the appropriate mobile devices to access the warnings. According to the responses, the most credible source of information was the authorities, e.g., Civil Defence, Fire and Emergency and Police (see Figure 4.17).

The results suggest that there is room to improve the official warnings, especially in rural areas. Authorities are seen as credible sources of official warnings, but it is suggested that multiple modes of communication, e.g., mobile phones, web pages, and radio, should always be used to reach a larger cross-section of the population.

Visual fire cues were perceived by almost everyone (98%) regardless of the households located in rural or urban areas. Smoke was the most perceived cue as it was seen and smelt by 97% and 76% of the households, respectively, in rural and urban areas (see Figure 4.18).

5.3 Decision to evacuate

The data illustrates that a majority of households (96%) decided to evacuate as the communities were ordered to do so (see Table 4.5). The main reason for the evacuation was the order to leave delivered by authorities, while the second most important was the direct perception of fire cues (see Figure 4.25). A small proportion of households (4%) decided to stay in place (see Table 4.5). According to the end-of-survey comments (see Section 4.5.2), some respondents believed people should have the right to determine themselves if they are able to evacuate, while others believed the evacuation order was an overreaction.

Although only a small proportion of households decided to stay despite the evacuation order, research should further explore possible reasons for staying in place in case of wildfire emergencies. This information can be used to determine what information is needed to convince people to evacuate.

The average response time (i.e. the time to get ready to leave after the decision was taken) was around one hour in both rural and urban areas. The households used this time to pack, secure their home and decide where to evacuate (see Figure 4.28). It is believed that this time can potentially be shortened if households in wildfire-prone areas are better prepared. As mentioned earlier (see Section 5.1), one potential way to increase preparedness is to put more resources in place to inform households about the risks, as well as possible measures and plans required to mitigate the risk.

5.4 Open comments

Several households provided additional comments on different aspects of the emergency. While there were many positive comments on the cohesion of the community and outstanding job by authorities, several concerns were raised about how the information was provided to the community.

As previously mentioned, some households complained about not having the right to stay and protect their properties. There were also complaints about the length of time they were kept out of their properties, the process required to get back to their properties (the re-entry process), as well as the information and support during re-entry. Respondents also raised concerns about the lack of support for people with disabilities during the evacuation stage, the management of livestock in the evacuation areas and the fact that curious members of the public blocked some of the evacuation routes.

As many of the above concerns and issues were only mentioned in the end-of-survey comments, they have not been extensively explored in this study. Future research should, therefore, further explore aspects of the emergency highlighted by respondents.

5.5 Limitations

One of the limitations of the study is that the data was collected seven months after the event. This relatively long timeframe could have affected the accuracy of the information provided by respondents. Also, the use of a questionnaire based on close-ended questions might have precluded the respondents from exactly explaining the evacuation process. To mitigate this issue, an open comment section was introduced at the end of the questionnaire.

The analysis in this report is based solely on the results of the Pigeon Valley survey. Further work is required to fully integrate the results with results from the limited number of other studies of wildfire events, e.g. Port Hills and other locations (Jakes & Langer, 2012; Langer et al., 2018; Lisa Langer & McGee, 2017; McGee & Langer, 2019).

6. Conclusion

This work provides insights into how 152 households affected by the Pigeon Valley Fire in 2019 perceived the wildfire threat and responded to it. Based on the information, it is clear that people had a relatively low level of wildfire preparedness and awareness of the wildfire threat in their area. The data indicate that households received direct warnings by authorities and/or second-hand information by family, neighbours or friends. The data also highlight the need for improvement of the official warning procedures. Finally, most people responded following the evacuation instructions, and it took them about one hour to prepare before starting to evacuate.

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Appendix – Boxplot interpretation

Boxplots are a simple way of representing statistical data, as they allow the visualisation of the following statistics:

- *Average,*
- *Minimum value (excluding outliers),*
- *Maximum value (excluding outliers),*
- *25th percentile: 25% of data have a smaller value of this threshold,*
- *50th percentile (median): 50% of data have a smaller value of this threshold,* and
- *75th percentile: 75% of data have a smaller value of this threshold.*
- *Outliers are data points that differ significantly from other observations.*

Figure A.1 provides the information on how to interpret boxplots

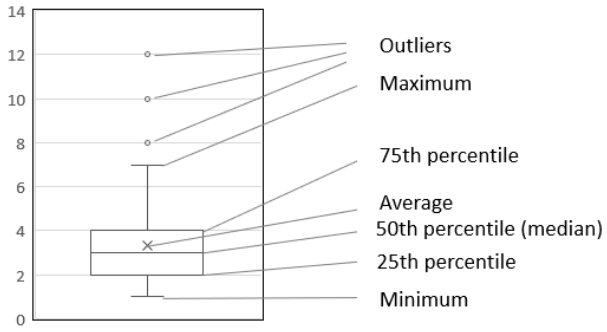

Figure A.1 – Boxplot interpretation.