How do people perceive flood risk? Findings from a public survey in Tuscany, Italy

Federica Zabini1 | Valentina Grasso1,2 | Alfonso Crisci1 | Bernardo Gozzini2

1 National Research Council, Institute of Bioeconomy, Florence, Italy
2 LaMMA Consortium, Environmental Modelling and Monitoring Laboratory for the Sustainable Development, Florence, Italy

Correspondence
Valentina Grasso, National Research Council, Institute of Bioeconomy, Italy.
Email: valentina.grasso@ibe.cnr.it

Abstract
The study of risk perception (RP) has much increased in the last years to improve flood risk management. Effective communication requires an understanding of how the risk of flooding is perceived by residents of different areas. In this work, RP is investigated through a survey involving 483 people living in Tuscany. RP was assessed through a score built on four items covering personal, residence, and sociodemographic variables concerning flood RP. Results showed that: (a) flood RP was moderate; (b) RP was positively correlated with age, higher education, proximity to a river and direct experience; (c) people who experienced floods felt themselves to be more informed and prepared; (d) subjectively perceived risk and experts’ risk assessment seemed generally correlated, even if people living in areas at “high risk” tend to underestimate the actual flood risk level; (e) the majority of the respondents considered the government and themselves as equally responsible for personal preparedness; and (f) less than 20% was aware of a Local Emergency Plan. The need of focusing on people living in the riskiest areas with targeted communication campaigns on risk awareness, hazard preparedness, and other implications of the findings in terms of communication strategies are discussed.

KEYWORDS
integrate flood risk management, risk communication, risk perception

1 | INTRODUCTION

It is recognized by many studies that understanding the factors influencing local flood risk perception (RP) of a community is crucial to achieving sound and effective risk communication (Burns & Slovic, 2012; Terpstra, Lindell, & Gutteling, 2009) and improves the resilience of local communities to natural hazards (Bradford et al., 2012).

In recent years, there has been an increase in the number of studies on RP of natural hazards, focusing on various aspects of flood RP. For a systematic review, see Bubeck, Botzen, and Aerts (2012), Wachinger, Renn, Begg, and Kuhlicke (2013), Kellens, Terpstra, and DeMaeyer (2013), Raska (2015), and Lechowska (2018). This growth is partly due to the shift in flood risk management toward a more comprehensive approach where RP may influence an individual’s willingness to adopt precautionary measures and eventually mitigate flood impacts (Birkholz, Muro, Jeffrey, & Smith, 2014; Schanze, 2007). This approach is also encouraged in national policies across Europe, based on a mix between...
the assessment and mitigation of flood risk and a general societal analysis, and strengthened by the EU Floods Directive 2007/60/EC (European Parliament and the Council of the European Union 2007) (Bradford et al., 2012). Even if flood RP is not always a strong predictor of mitigation behavior (Bubeck, Botzen, Suu, & Aerts, 2012; Miceli, Sotgiu, & Settanni, 2008), its assessment could provide policymakers with indications of the risks perceived as high by the public. This could then act as an indicator of the public's need for education about flood risk.

The wide literature on flood RP often shows fragmented results (Kellens et al., 2013). The variables involved in RP and preparedness are numerous and their roles and weights differ depending on cultural and geographic contexts and factors varying in space and time (Botzen, Aerts, & van den Bergh, 2009). The question has been extensively studied by numerous authors with such different disciplinary backgrounds as psychology (Fischhoff, Bostrom, & Quadrel, 1993; Slovic, 1987), anthropology (Douglas & Wildavsky, 1982; Thompson, Ellis, & Wildavsky, 1990), and sociology (Beck, 1992; Renn, 2008). These studies focused alternatively on the role in shaping individual RP played by subjective cognitive frames, cultural traits and worldviews, social norms and beliefs, political and institutional milieu. In general, the attempt to identify the factors influencing how communities conceptualize risk revealed the fleeting nature of RP and the difficulty in isolating strong and unequivocal predictors (Sjoberg, 2000). The general evolution of RP and communication (Fischhoff, 1995) are reviewed in comparative studies in RP (Boholm, 1998) and risk communication to the public (Bier, 2001).

The need for a country-specific examination focusing on local public perceptions is recognized by several studies (Kellens et al., 2013). The influence of local political traditions and social contexts on flood RP should also be considered when implementing risk reduction strategies (Raska, 2015).

1.1 | Italian context

Though individual and collective risks posed by floods to the Italian population are well studied, both on the national and local scales (Guzzetti, Stark, & Salvati, 2005; Salvati, Bianchi, Rossi, & Guzzetti, 2010), research into the public perception of flood risk in Italy is in its early stages. This research explored the flood RP of residents in small rural areas, mainly in Alpine zones exposed to hydrogeological risk in the North of Italy (Miceli et al., 2008; Scolobig, De Marchi, & Borga, 2012), and in larger urban areas (Mysiak et al., 2013) with a long track record of severe floods. Two national surveys (Salvati et al., 2014) showed a general tendency to underestimate flood risk, highlighting an evident gap between the actual risk posed by landslides and floods to the local population and their perception of the dangerousness of hydrogeological events.

Italy is the second most country hit by floods in Europe in the last decades (17% of the total) holding the record for highest death toll (38%; Llasat & Siccardi, 2010). The rugged and mountainous terrain and Mediterranean climate variability make the Italian territory frequently exposed to flood events that affect regions and population in a very fragmented way (Mysiak et al., 2013; Salvati et al., 2010). The areas prone to significant flood and/or landslide risk cover over 29,500 km² (approximately 9.8% of the territory; MATTM, 2008; Mysiak et al., 2013) with about 3.5 million people living in these areas (Legambiente, 2010). In the period 1900–2008, there were 2,321 flood events in Italy (Salvati et al., 2010) among which the 1966 Florence flood is probably one of the most vividly impressed calamities in the collective memory.

The expected occurrence of extreme floods shows a worsening trend, related to an increase in their frequency and intensity due to the climate-change-induced modification of rainfall patterns (Feyen, Dankers, Bódis, Salamon, & Barredo, 2012). Floods usually affecting the Italian territory, as in the Mediterranean Region overall, are flash floods associated with extreme rainfall events with high uncertainty in the weather forecasting process (Llasat & Siccardi, 2010). This uncertainty poses a further challenge to achieving effective communication and preparedness among citizens.

This study intends to contribute to advancing the understanding of the way people perceive risks related to floods, including in the framework of the implementation of the EU Floods Directive (2007/60/EC) that calls upon a more holistic approach to flood risk governance with RP and communication gaining a significant role.

This article presents, first, the results of a public survey of 483 people living in Tuscany conducted from April to May 2016 by the Environmental Modelling and Monitoring Laboratory for the sustainable development (Laboratorio di Monitoraggio e Modellistica Ambientale per lo sviluppo sostenibile—LaMMA), an Italian governmental consortium set up by the Italian National Research Council (CNR) and the Tuscany Regional Government. LaMMA is the public regional forecasting service and is also in charge of issuing weather alerts for Tuscany.

The study discusses and offers some contributions to improve the study of the public perception of flood risk in the Italian context of Tuscany. In particular it explores
the factors influencing RP, compares the relationship between objective and subjective flood risk, and investigates people’s attitudes toward information, preparedness, and confidence in risk management authorities.

2 | METHODOLOGY

2.1 | Survey data collection and sample characteristics

The survey presented in this article was conducted in April and May 2016. Participants filled out an anonymous online questionnaire published on the LaMMA website. Seven hundred and five people completed the survey. As the survey was on a voluntary basis with no active recruitment, participants were likely already interested in the survey topic and frequently accessed the LaMMA website. Student participation in the survey was encouraged by collaboration with some schools involved in “Arno River 2016,” a project commemorating the fiftieth anniversary of the Arno River flood and representing a novelty in the current Italian flood RP literature. However, respondents under 18 years old were only 52, 11% of the whole. The narrow dimension of this sub-sample did not allow to run analysis for this specific group and confront results with the bigger set of adult respondents (462); in fact, the number and variability of the two samples are not comparable. Youngsters were considered as one of the age-classes represented in the dataset.

Due to the data collection method chosen, the sample cannot be considered representative of the wider Italian population (Fricker, 2008). For this research, we limited the analysis to the subset of 483 respondents living in Tuscany who provided the required information for geolocation. The sample size at least is sufficient to conduct comparisons with other studies on RP (Lindell & Perry, 2000) and to make assessments regarding local RP and preparedness in case of a flood.

2.2 | Design of the survey questionnaire

The survey was drawn from previously published studies to allow direct comparison between findings.

The questionnaire asked for home address information so as to geolocate respondents on the Tuscany Flood Hazard map and compare their subjective RP (“perceived risk”) with experts’ risk assessment (“objective risk”). The map presents five hazard levels ranging from “very high risk” to “no risk” (map is available at http://www502.regione.toscana.it/geoscopio/alluvioni.html). The same levels were selected for the perceived risk answer in order to match it with the risk attributed to their home location on the Flood Hazard map. All items were mandatory to complete the survey. A draft version of the questionnaire was previously presented to a limited sample to verify the consistency and clarity of questions. As the questionnaire is extensive, only the questions relevant to the focus of the present study are discussed here (see Appendix).

2.3 | Risk perception measure

Flood RP is the self-subjective judgment of the perceived probability of a flood occurrence (Grothmann & Reusswig, 2006; Lindell, Arlikatti, & Prater, 2009; Siegrist & Gutscher, 2008) and its perceived severity in terms of consequences (Lindell & Hwang, 2008; Tekeli-Yeşil, Dedeoğlu, Braun-Fahlænder, & Tanner, 2010). Numerous factors influence this perception, mainly personal and contextual attributes and past experiences of floods.

In this study, RP was measured through the following four items: the perceived flood risk for the area of residence; the likelihood that a flood would occur in the future; the perceived impact of a future event; and the perceived personal vulnerability in case of a potential flood. The first two items were measured using a 5-point Likert scale, while the last two were dichotomous questions. A Risk Perception Score (RPS) was created by summing the scores of the first two items. RPS values ranged from 2 to 10 where higher values indicate greater RP. The RPS represents a relative measure of flood RP for each respondent. The other two items, not included in the score, contribute to drawing the perception of flood risk for this Tuscany sample.

In the survey, we also investigated the perception of natural and artificial risks using a set of questions meant to measure self-perceived exposure to nine different types of risk (car accident; fire; flood; landslide; earthquake; pollution; electromagnetic pollution; theft; terrorism). We asked respondents to rate on a scale ranging from 0 (not at all exposed) to 3 (extremely exposed) how exposed they feel toward different risks. For this purpose, we created the Perceived Exposure to Risks (PER) index by summing up the scores of eight items, excluding flood. The PER can be considered a general risk exposure index that could be compared with the RPS and provide further insights for a more comprehensive analysis.

2.4 | Data analysis

Data analyses were performed as follows. First, we conducted a descriptive analysis of the whole dataset, also
| Variable | N   | %   | Average RP score | SD  | Variable | N   | %   | Average RP score | SD  |
|----------|-----|-----|------------------|-----|----------|-----|-----|------------------|-----|
| RPS score (from 2 to 10) | 4,91 | 1,93 |                  |     |          |     |     |                  |     |
| Age      |      |     |                  |     |          |     |     |                  |     |
| Under 18 | 52  | 11% | 4,10             | 1,43| 0        | 5   | 2%  | 4,60             | 2,30|
| 18-30    | 52  | 11% | 4,37             | 1,65| 1        | 37  | 17% | 5,76             | 2,07|
| 31-50    | 202 | 42% | 4,94             | 2,00| 2        | 72  | 33% | 5,18             | 1,92|
| Over 50  | 177 | 37% | 5,28             | 1,96| 3        | 106 | 48% | 5,73             | 2,06|
| Education |     |     |                  |     |          |     |     |                  |     |
| Low      | 78  | 16% | 4,33             | 1,70| No damages | 79  | 36% | 4,91             | 1,59|
| Medium   | 240 | 50% | 5,04             | 2,06| Damages to relatives | 58  | 26% | 5,14             | 2,04|
| High     | 165 | 34% | 4,99             | 1,79| Damages to properties | 41  | 19% | 6,20             | 2,03|
|          |     |     |                  |     |          |     |     |                  |     |
| Gender   |     |     |                  |     |          |     |     |                  |     |
| Male     | 329 | 68% | 4,83             | 1,94|              |     |     |                  |     |
| Female   | 154 | 32% | 5,08             | 1,90|              |     |     |                  |     |
| Fear experienced |     |     |                  |     |          |     |     |                  |     |
| Not scared at all | 98  | 45% | 5,02             | 1,66|              |     |     |                  |     |
| House type |     |     |                  |     |          |     |     |                  |     |
| Block of flats | 296 | 61% | 4,86             | 1,88| For property damage | 58  | 26% | 5,90             | 2,14|
| Single-family house | 187 | 39% | 4,99             | 2,02| For my family | 44  | 20% | 6,16             | 2,21|
| For my own life | 20  | 9%  | 5,55             | 2,46|              |     |     |                  |     |
| Length of time at current residence |     |     |                  |     |          |     |     |                  |     |
| 0-3      | 62  | 13% | 4,69             | 1,86| 1        | 56  | 12% | 4,36             | 1,67|
| 4-10     | 123 | 25% | 4,98             | 1,91| 2        | 110 | 23% | 4,91             | 1,86|
| 11-25    | 168 | 35% | 5,01             | 1,85| 3        | 181 | 37% | 4,87             | 1,79|
| 26+      | 130 | 27% | 4,82             | 2,09| 4        | 98  | 20% | 5,15             | 2,11|
| Ground floor |     |     |                  |     |          |     |     |                  |     |
| No       | 377 | 78% | 4,85             | 1,85|              |     |     |                  |     |
| Yes      | 106 | 22% | 5,14             | 2,18|              |     |     |                  |     |
| River proximity |     |     |                  |     |          |     |     |                  |     |
| More than 1km | 107 | 22% | 4,03             | 1,82|              |     |     |                  |     |
| About 1km | 111 | 23% | 4,74             | 1,78|              |     |     |                  |     |
| About 500m | 160 | 33% | 5,10             | 1,77| Government | 96  | 20% | 4,70             | 2,06|
| Less than 100m | 105 | 22% | 5,70             | 2,06| Fifty-fifty | 323 | 67% | 4,93             | 1,85|
| Personal | 64  | 13% | 5,14             | 2,12|              |     |     |                  |     |
| Home ownership |     |     |                  |     |          |     |     |                  |     |
| Home owner | 410 | 85% | 4,92             | 1,98|              |     |     |                  |     |
| Renter   | 73  | 15% | 4,88             | 1,63|              |     |     |                  |     |
| Flood experience |     |     |                  |     |          |     |     |                  |     |
| No       | 263 | 54% | 4,40             | 1,68|              |     |     |                  |     |
| Yes      | 220 | 46% | 5,53             | 2,03|              |     |     |                  |     |
summarizing RPS for a set of variables selected from the literature and commonly used to explore people’s flood RP drivers.

A correlation analysis was then performed to examine if an association exists among RPS and variables such as socio-demographic attributes, house location characteristics, and experience. Non-parametric correlation (Spearman) was calculated to avoid potential biases due to non-Gaussian variables distribution. Correlation coefficients (rs) were evaluated by their significance values conveyed by the p-value ($\rho$). Asterisks were placed next to the coefficient only when the p-value ($\rho$) was .5 or lower, as here defined: **** for $\rho < .0001$; *** for $\rho < .001$; ** for $\rho < .01$; * for $\rho < .05$. Four asterisks express the maximum significance.

The software used to perform the statistical analyses was R (R Core Team, 2018).

For the items used to explore knowledge, confidence in different information sources, and perceived responsibility, the data were analyzed using descriptive analytics such as frequency distribution and percentage of the collected data.

### RESULTS

#### 3.1 Sample characteristics

The frequencies (number and percentage) of the sample characteristics are displayed in Table 1. Among the 483 respondents 79% were over the age of 31 and 11% were below 18 years old.

The large majority of the sample is composed of males (68%) with a medium-high level of education (56%).

A high percentage of respondents were homeowners; 62% lived permanently (more than 10 years) in the current residence and only 22% of them lived at ground floor level.

More than half indicated that they live close to a river (22% less than 100 m away, 33% about 500 m away). Almost half of the respondents (46%) reported having suffered a flood in their lifetime; among them, 11% suffered more than one flood. Only 17% had experienced a flood event in the last 7 years. More than one third reported damages to personal property as a
| Variables                              | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---------------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| RP score                              | 1  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Age                                   | 2  | 0.19**** |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Education                             | 3  | 0.10* | 0.21**** |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Gender                                | 4  | 0.06 | 0.04 | 0.07 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| House typology                        | 5  | 0.02 | −0.04 | 0.00 | −0.05 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Length of time                        | 6  | 0.00 | 0.20**** | −0.01 | 0.00 | 0.12** |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Ground floor                          | 7  | 0.04 | 0.05 | −0.10* | −0.05 | 0.14** | −0.05 |    |    |    |    |    |    |    |    |    |    |    |    |    |
| River proximity                       | 8  | 0.25**** | 0.15**** | 0.04 | −0.04 | −0.09 | −0.02 | 0.05 |    |    |    |    |    |    |    |    |    |    |    |    |
| Home ownership                        | 9  | −0.01 | 0.12** | 0.10* | −0.03 | 0.10* | 0.26**** | −0.06 | 0.01 |    |    |    |    |    |    |    |    |    |    |    |
| Flood experience                      | 10 | 0.28**** | 0.43**** | 0.05 | 0.02 | 0.08 | 0.15** | 0.04 | 0.14** | 0.07 |    |    |    |    |    |    |    |    |    |    |
| PER                                   | 11 | 0.09 | 0.04 | 0.15*** | 0.19**** | −0.02 | −0.06 | −0.12** | −0.05 | −0.02 | 0.01 |    |    |    |    |    |    |    |    |    |
| Perceived flood impact                | 12 | 0.32**** | 0.25**** | 0.11* | 0.03 | 0.01 | 0.12* | 0.08 | 0.16*** | 0.06 | 0.10* | 0.04 |    |    |    |    |    |    |    |    |
| Perceived flood vulnerability         | 13 | 0.20**** | 0.08 | 0.10* | 0.01 | 0.09* | 0.00 | −0.03 | 0.02 | −0.09 | 0.05 | 0.20**** | 0.22**** |    |    |    |    |    |    |
| Level of feeling informed             | 14 | 0.09* | 0.04 | 0.04 | −0.10* | 0.13** | 0.11* | −0.02 | 0.03 | 0.05 | 0.19**** | 0.02 | −0.02 | 0.02 |    |    |    |    |    |
| Perceived preparedness                | 15 | −0.04 | −0.05 | −0.02 | −0.06 | 0.04 | 0.02 | 0.00 | 0.02 | 0.02 | 0.09 | 0.02 | −0.04 | 0.03 | 0.22**** |    |    |    |    |
| Knowledge emergency plan              | 16 | 0.08 | 0.03 | 0.03 | −0.08 | 0.02 | 0.07 | −0.06 | 0.05 | 0.04 | 0.14** | 0.02 | 0.09* | 0.02 | 0.34**** | 0.11* |    |    |    |
| Training attendance                   | 17 | −0.07 | −0.16**** | −0.08 | 0.05 | 0.08 | −0.07 | −0.01 | −0.07 | −0.02 | 0.02 | 0.02 | −0.07 | 0.02 | 0.15*** | 0.10* | 0.25**** |    |    |    |
| Trust in experts                      | 18 | −0.02 | −0.01 | 0.00 | 0.02 | 0.01 | 0.01 | 0.02 | 0.02 | −0.03 | 0.03 | 0.00 | −0.06 | 0.02 | −0.02 | 0.00 | −0.03 | −0.04 |    |
| Trust in emergency managers           | 19 | 0.01 | 0.03 | 0.05 | 0.05 | 0.05 | −0.01 | −0.04 | 0.01 | −0.05 | −0.03 | 0.01 | −0.01 | −0.07 | 0.04 | 0.02 | 0.01 | −0.13*** | 0.46**** |
| Trust in local governors              | 20 | 0.01 | −0.08 | 0.04 | 0.04 | 0.01 | −0.01 | 0.00 | −0.02 | −0.08 | −0.07 | 0.00 | −0.01 | 0.01 | 0.08 | 0.06 | 0.00 | −0.01 | 0.23**** | 0.39**** |
| Responsibility in preparedness        | 21 | 0.07 | −0.12** | 0.01 | −0.07 | 0.05 | −0.03 | −0.01 | −0.03 | 0.03 | 0.01 | 0.04 | 0.00 | −0.01 | 0.21**** | 0.12** | 0.10* | 0.06 | −0.03 | −0.03 | −0.02 |

Note: **** ρ < .0001; *** ρ < .001; ** ρ < .01; * ρ < .05.
consequence of a flood, 18% reported damages to their home, while only 1% suffered personal injuries. For 106 out of the 220 respondents who experienced a flood, the event had a significant impact, with interruption of public services (gas, electricity, water), closure of important roads, and general damages in their neighborhood. Asked to recall the feelings they experienced during the flood, half of the respondents reported they were not scared at all, while more than one third were scared for their property (26%) or for their family (20%).

### 3.2 Flood RP: Overview and factors affecting perception

Overall, respondents showed a moderate perception of flood risk: average RPS was 4.91, where values ranged from 2 to 10, with a SD of 1.93. Different values of RPS emerge when considering a stratification of users by gender, education level, previous flood experience, and other variables, as summarized in Table 1.

Results from the other two dichotomous questions aimed at further exploring the perceived impact and exposure to floods show that two-thirds of the respondents (67%) believed they would suffer some damage from a possible flood, and 70% believed that a flood could be a real threat to their personal safety.

Correlation analysis (Table 2) showed that RP, as measured by RPS, is correlated with socio-demographic dimensions like age \( r_s = .19^{**} \) and education \( r_s = .29^{****} \). Also living close to a river increases RP \( r_s = .29^{****} \).

People who have experienced a flood demonstrated higher values of RPS (5.53) compared to those who have not (4.40), with the two variables showing a significant correlation \( r_s = .28^{****}; \text{Table 2} \). Moreover, for this sub-sample of respondents, RP score increased if the previous flood caused damages \( r_s = .32^{****} \) and they felt scared during the event \( r_s = .19^{**} \).

Overall, there is a stronger correlation between RP and the perceived flood impact and vulnerability. RP is significantly correlated with the perceived impact of the flood \( r_s = .39 \) meaning that those with a higher level of RP tend to think that a flood would cause damages to their properties or home. Correlation is \( .20^{****} \) between RPS and the perceived personal vulnerability to a possible flood (Table 2). Perceived vulnerability is also correlated to Perceived Exposure to Risks (PER), a more general risk index. This PER index was correlated with education and gender, where women felt more exposed to risk compared to men.

The coefficients presented in the study show rather low correlation values; however, this should not be considered a limit in describing any inferences in the interpretation of the data. Weak correlations are not unusual in this type of survey as the factors contributing to the perception of risk are numerous and differ greatly from one person to another. The study interest is not to identify the robustness of single variables, but rather to detect which socio-demographic factors influence RP in this specific context. Furthermore, since it is an exploratory analysis of a sample of volunteers with an unguided compilation, the presence of weak values is not unexpected.

### 3.3 Objective and subjective risk

Respondents were geolocated in order to compare the relationship between experts’ risk assessment (“objective risk”) and respondents’ flood RP (“perceived risk”), a topic extensively investigated in many studies on RP (Rowe & Wright, 2001; Slovic, Fischhoff, & Lichtenstein, 1985; Thomson, Önkal, Avciogluz, & Goodwin, 2004; Wright, Bolger, & Rowe, 2002). A correlation analysis was used to test the influence of RPS and that of the single items within it (see Table 3).

Results showed that individual RP and “objective risk” assessed by experts were positively correlated: RPS revealed a significant correlation value of \( .34^{****} \) and flood risk estimate for respondents’ area of residence showed a correlation of \( .39^{****} \). These results confirm a correlation between perceived and actual flood risk of the area of residence.

Based on the information provided by respondents, the distribution of residents among the five classes of objective risk is quite homogeneous (32% none, 36% medium, 32% high or very high risk). For what concerns the subjective perceived risk, 19% of respondents estimated the risk of flooding of their neighborhood as high or very high, 64% indicated the medium category, and 17% believed there is no risk at all.

Regarding residents’ ability to accurately estimate the flood risk to their household area, analysis shows that 51% of respondents identified correctly the class of flood risk, 25% underestimated, and 24% overestimated it.

The majority of people living in the riskiest areas underestimated their household flooding risk. Underestimating risk may imply a false sense of security and, potentially, a lower preparedness. In detail, people living in areas assessed by experts as having “no flood risk” tend to overestimate (65%) or correctly identify the risk level (35%); people living in areas assessed as medium...
flood risk tend to correctly identify the risk level (77%); while 64% of those living in the riskiest areas (high and very high classes) underestimate the risk of flooding (Figure 1).

### 3.4 Information and preparedness

Several items of the survey were directed to explore issues related to information about floods and personal preparedness.

Less than one-third (28%) of respondents feel well informed about flood risk in their area (4/5 levels of the Likert scale); and more than one-third affirmed to be little (23%) or not at all (12%) informed.

When it comes to reporting if they are aware of the local emergency plan, only 13% are informed of the plan, and though 22% are aware that a plan exists, they ignore its contents. More than half of the respondents (60%) are totally unaware if an emergency plan exists.

If we consider the emergency plan as a solid pillar of a preparedness strategy, it is surprising that so many ignore...
### TABLE 4  Correlations between study variables on the sub-sample of respondents who had experienced a flood (N = 228)

| Variables                     | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  |
|-------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1. RP score                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 2. Age                       | 0.03|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 3. Education                 | -0.02| 0.02|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 4. Gender                    | 0.05| 0.03| 0.05|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 5. House typology            | 0.01| -0.20***| 0.05| -0.08|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 6. Length of time             | -0.01| 0.30****| -0.08| 0.00| 0.16*|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 7. Ground floor              | 0.06| -0.02| -0.14*| -0.09| 0.14*| -0.11|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 8. River proximity           | 0.27****| 0.10| -0.01| -0.08| -0.06| -0.04| 0.10|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 9. Home ownership            | 0.05| 0.08| 0.23***| 0.00| 0.19**| 0.29****| -0.05| 0.00|     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 10. More than one flood      | 0.15| -0.01| 0.07| 0.07| 0.28***| 0.08| 0.13| 0.11| 0.11| 0.11|     |     |     |     |     |     |     |     |     |     |     |
| 11. Flood recency            | -0.10| 0.60*****| 0.07| 0.08| -0.29***| 0.21**| -0.13| -0.02| 0.00| -0.34****|     |     |     |     |     |     |     |     |     |     |
| 12. Flood damages            | 0.32****| 0.12| -0.11| -0.01| 0.06| 0.12| 0.08| -0.01| 0.05| 0.09| 0.09|     |     |     |     |     |     |     |     |     |
| 13. Flood magnitude          | 0.08| 0.07| -0.10| -0.02| 0.04| 0.12| 0.01| -0.12| 0.05| 0.07| 0.15| 0.20**|     |     |     |     |     |     |     |
| 14. Fear experienced         | 0.19***| 0.04| -0.04| 0.12| -0.01| 0.02| 0.14*| -0.03| -0.06| 0.15*| 0.05| 0.35****| 0.17**|     |     |     |     |     |
| 15. PER                      | -0.06| -0.09| 0.13| 0.25***| -0.01| -0.11| -0.05| -0.07| -0.04| 0.15| -0.02| -0.11| -0.04| 0.15*|     |     |     |     |     |
| 16. Perceived flood impact   | 0.39****| 0.15*| 0.02| 0.06| -0.10| 0.07| 0.11| 0.06| -0.02| 0.00| 0.10| 0.20**| 0.02| 0.17*| -0.01|     |     |     |     |     |
| 17. Perceived flood vulnerable. | 0.21***| -0.10| -0.02| 0.01| 0.02| -0.10| 0.05| 0.00| -0.10| 0.07| -0.04| 0.09| 0.13| 0.14*| 0.15*| 0.17*|     |     |     |
| 18. Level of feeling informed | 0.04| -0.11| -0.07| -0.19**| 0.14*| 0.12| -0.05| 0.09| 0.12| 0.14| -0.24**| -0.03| 0.07| -0.06| -0.06| -0.08| 0.00|     |     |
| 19. Perceived preparedness   | -0.05| -0.11| -0.01| -0.02| 0.05| -0.06| 0.05| 0.11| 0.04| -0.01| -0.12| -0.05| 0.00| -0.13| -0.02| -0.03| 0.05| 0.10|     |     |
| 20. Knowledge em. plan       | -0.02| -0.14*| -0.06| -0.09| 0.02| 0.06| 0.00| -0.01| 0.04| 0.14| -0.18*| -0.13*| 0.06| -0.10| -0.04| 0.04| 0.00| 0.37****| 0.11|     |
| 21. Training attendance      | -0.11| -0.16*| 0.01| 0.02| 0.12| -0.07| 0.00| -0.08| 0.00| 0.16*| -0.24**| -0.08| 0.08| -0.07| 0.04| -0.10| 0.12| 0.22**| 0.03| 0.33****|
| 22. Trust in experts         | 0.01| 0.02| -0.01| -0.01| -0.08| -0.03| 0.05| 0.11| -0.09| -0.06| 0.15| -0.10| 0.01| -0.08| 0.02| -0.03| 0.01| -0.06| -0.06| 0.01| -0.08|
| 23. Trust in em. managers    | 0.03| 0.09| -0.01| 0.01| 0.03| 0.07| -0.06| 0.07| -0.04| -0.05| 0.19*| -0.01| 0.01| -0.01| -0.05| 0.01| -0.10| 0.06| -0.03| -0.05| -0.17*| 0.39****|
| 24. Responsib. In preparedness | 0.00| -0.23***| 0.07| -0.06| 0.10| -0.10| 0.00| -0.06| -0.01| -0.02| -0.22**| -0.05| -0.01| -0.02| 0.07| -0.03| -0.01| 0.26***| 0.11| 0.08| 0.06| -0.03| -0.07|

Note: **** $p < .0001$; *** $p < .001$; ** $p < .01$; * $p < .05$. 
it, especially considering that 49% affirm to be prepared to face a possible flood. This inconsistency also emerges in the correlation matrix (Table 2) where the perceived preparedness shows a very weak correlation with knowledge of emergency plans, which in turn has a more robust correlation with the perceived level of information ($r_s = .34^{****}$). Personal perception of being prepared and being informed are also correlated ($r_s = .22^{****}$).

Having experienced a flood does not change significantly the correlation among these dimensions (Table 4). For the subset of respondents who experienced one or more floods, the perceived level of information is negatively correlated with flood recency ($r_s = -.24^{**}$): the further in the past the flood happened, the more the information level declines.

Along with preparedness, we also considered personal participation in training: only 11% of respondents took part in training. Correlation between training participation and the knowledge of emergency plans was $25^{****}$ for the whole sample (Table 2) and $33^{****}$ for those who experienced a flood (Table 4). Correlation between training participation and the level of being informed was a bit weaker ($r_s = .15^{**}$).

Overall, the only proactive mitigation measure undertaken by a majority of users (66%) is to keep themselves updated through the regional weather warning system.

### 3.5 Trust, confidence, and responsibility in preparedness

The majority of respondents considered that factors determining the occurrence of a flood are mostly related to public management of the territory. As displayed in Figure 2, natural factors like soil characteristics are regarded less important than anthropogenic ones, like those related to land management and land use change. Almost half of the respondents blame the low interest of public administrators.

Likewise, in response to the question “Why are floods dangerous for the community,” 62% considered flood danger to be due to mismanagement by local authorities (Figure 3).

At the same time, data showed a general confidence in the increased capacity of the emergency management system to face floods compared to past events. More than half of the respondents (55%) believe that the forecasting capacity has improved compared to the exceptional Arno River flood of 1966, and up to 65% state that risk management capacity has also increased.

Besides this confidence, there is an overall lack of confidence among respondents in the possibility of being promptly informed. As many as 44% of respondents believe they would not be adequately informed in case of a flood. Asked about the various information sources, they think they would be primarily informed through

![FIGURE 2 Factors contributing to floods. Bars show the importance attributed by respondents to each factor, from no confidence (light shade) to much confidence (dark shade). Factors listed from the top: the lack of defense works; climate change; deforestation; characteristics of the soil; little interest of public administration; modification of the course of rivers; bad luck](image-url)
TV, social networks, and institutional Civil Protection website.

High confidence was expressed in the information provided by experts and civil protection, whereas nearly half of respondents expressed low levels of confidence in local authorities such as mayors, as showed in Figure 4.

Data on confidence (stratified by age groups) in the different information sources indicate that environmental associations are particularly trusted by people under 18 years old, as are the press and the internet; while confidence in the police increases with age (see Table A1 in Appendix).

Although results indicate an implicit lack of trust toward local government in terms of public management of the territory, the trustworthiness of experts and authorities providing information during the events is strong and solid.

A critical dimension in risk management that we explored is people’s beliefs about who they consider responsible for their protection from a hazard. In the present study, 20% of respondents regarded the government as primarily or exclusively accountable for their preparedness level, while 13% assigned this responsibility to citizens. More than two-thirds (67%) believe that responsibility is up to both institutions and citizens.

4 | DISCUSSION

4.1 | Factors influencing RP

The influence of sociodemographic factors on RP has been investigated in the literature with different, and

![Pie chart showing reasons for low confidence in local authorities.](image)

**FIGURE 3** “Why are floods dangerous for the communities?”. Pie-chart shows answers in percentage

![Bar chart showing level of confidence in different sources of information.](image)

**FIGURE 4** Level of confidence that respondents have in the different sources of information on flood risk. Sources of information listed from the top: senior citizens; other people; mayors; Law enforcement; Experts; Emergency managers. Bars represent in percentage the level of confidence, from no confidence (light shade) to much confidence (dark shade)
sometimes contradictory, results. Age, for example, has been found to be (positively or negatively) correlated to RP of floods (Kellens, Zaalberg, Neutens, Vanneuville, & Maeyer, 2011; Lindell & Hwang, 2008; Miceli et al., 2008; Morss, Mulder, Lazo, & Demuth, 2015; Ruin, Gaillard, & Lutoff, 2007), while other studies found no relevant age-dependency (Grothmann & Reusswig, 2006; O’Neill, Brereton, Shahumyan, & Clinch, 2016; Pagneux, Gisladóttir, & Jónsdóttir, 2011; Siegrist & Gutscher, 2006; Sjoberg, 2000).

Our results support an age-related correlation, highlighting the tendency of people under-30 years of age to underestimate the risk posed by floods (Grothmann & Reusswig, 2006; Kellens et al., 2011), even due to the lower probability that young people have experienced floods, whereas it disagrees with other studies where younger respondents reached higher scores on the Perception of Flood Risk Scale (PFRS) than older respondents (Miceli et al., 2008).

As suggested by several authors, RP was correlated with education (Botzen et al., 2009; Cunningham, Lecturer, Fielding, & Thrush, 2008; Kellens et al., 2011; O’Neill et al., 2016). Although many studies report that less-educated people usually tend to have higher levels of RP (Armas & Avram, 2009; Botzen et al., 2009; Ho, Shaw, Lin, & Chiu, 2008), in our sample well-educated respondents showed higher levels.

Gender did not seem to play a role in flood RP. Several previous studies (Gotham, Campanella, Lauve-moon, & Powers, 2017; Kellens et al., 2011; Miceli et al., 2008) have found men have, on average, lower perceived levels of flood risk than women, while others (Botzen et al., 2009; Ho et al., 2008) showed the opposite and in O’Neill et al. (2016) gender emerged as insignificant.

Here, gender was related to perceived exposure to risks, in line with other studies where gender is a strong predictor of attitudes toward natural disasters (Ho et al., 2008). Women in this study reached higher scores than men in PER index, in line with studies where they express higher levels of concerns than men toward different kinds of risks (Siegrist, Gutscher, & Earle, 2005).

A partial divergence with previous findings is not unexpected and confirms the context-dependent effects of socio-demographic variables on flood RP. Nevertheless, socio-demographic variables do not appear robust enough to be considered predictors of flood RP and they seem to be connected to other intervening factors.

Closeness to a river is one of the most important factors influencing the perception of flood risk (Burningham et al., 2008; Lindell & Hwang, 2008; Miceli et al., 2008), so the results are not surprising. Other studies also found that people living close to a river show a greater willingness to adopt protective behavior (Botzen, Aerts, & van den Bergh, 2013; Miceli et al., 2008). Contrary to expectations drawn from the findings of previous research (Grothmann & Reusswig, 2006; Lindell et al., 2008; Heitz, Spaeter, Auzet, & Glatron, 2009; Lindell and Hwang, 2008; Scolobig et al., 2012; O’Neill et al., 2016), variables about residence characteristics (such as living at ground floor, or in a block of flats or single-family houses) revealed no significant correlation with the perceived risk level. Neither length of residence (Burningham et al., 2008; Scolobig et al., 2012) nor homeownership (Burningham et al., 2008; Grothmann & Reusswig, 2006) emerge as relevant in shaping flood RP in the sample study.

Having a direct experience of a flood has been recognised in the literature as one of the most important factors shaping flood RP (Kellens et al., 2011; Lindell & Hwang, 2008; Miceli et al., 2008; Terpstra, 2011; Wachinger et al., 2013). According to a large part of the literature, those who experienced a flood tend to have higher perception of flood risk, particularly, if their property has been damaged or they felt worried during the flood. Moreover, they have a higher perception that, in the event of a future flood, they would suffer some damage and that their life would be threatened. RP is partially influenced by the memory of the event and by the feelings experienced. In our study, those who felt scared for their family, themselves, or their properties, showed higher values of RPS. RP was also higher for people who reported damages to their home or other personal values in a previous flood.

Immediately after a flood, the risk is perceived to be higher than it actually is, but after some time, people tend to be less worried, and flood RP decreases (Baan & Klijn, 2004). Moreover, these results confirm indirectly the hypothesis that individuals who experienced previous hazards without being personally affected are more likely to underestimate the likelihood and impact of a future event (Green, Tunstall, & Fordham, 1991; Miceli et al., 2008; Mileti & Brien, 1992; Scolobig et al., 2012).

### 4.2 Objective and subjective risk

Overall results highlight a relative correspondence between experts’ risk assessment (“objective risk”) and subjective flood RP (“perceived risk”). Nevertheless, as seen in other studies (Horney, MacDonald, Van Willigen, Berke, & Kaufman, 2010), people whose homes lie in a high-risk area tend to underestimate their risk level. This tendency has to be carefully considered when implementing communication strategies to raise awareness of flood risk. People living in risky zones should be better informed about the objective risk of their area and
become better prepared to take precautionary measures. Communication campaigns on hazard preparedness should be tuned to specific target groups and the riskiest areas. A cross-national study on RP of different hazards (Knuth, Kehl, Hulse, & Schmidt, 2014) confirms that people’s awareness of objective risk could influence their RP.

4.3 Responsibility, preparedness, confidence, and information: Implications for flood risk management

In this study, a set of questions about responsibility in flood events highlights a tendency to assign a central role to public management.

The general lack of trust in public administrators, believed to be unreliable, is coupled with a high confidence in other institutions like civil protection managers, scientists, and experts, perceived as being “trusted sources” of information about flood risk by half of the respondents. This attitude is also confirmed by the positive judgement about the improvement of forecasting and risk management capacity. This apparent contradiction may be clarified if we consider trust as a multidimensional concept, embracing different attributes like knowledge, expertise, ability, concern, care, honesty, and values (Mayer, Davis, & Schoorman, 1995; Peters, Covello, & McCallum, 1997; Renn & Levine, 1991). It is, thus, helpful to distinguish between trust and confidence (Siegrist et al., 2005), where the latter refers mainly to the knowledge/expertise dimension, while trust relates more to a general belief in honesty and concern.

Low confidence in mayors and general skepticism toward public management are certainly an issue to address in future communication campaigns. Experts and civil protection, seen as highly trusted sources of information, may help in making the public more aware of the efforts promoted by local government to increase flood mitigation actions. NGO and environmental organizations were recognized as a trusted source of information too and their involvement in risk communication and management could be fostered in future campaigns, acknowledging that this matter is no longer exclusive of public institutions (Corfee-Morlot et al., 2011). Information about risk is in fact more likely to be adopted when it is conveyed by trusted communicators (Seebauer & Babcicky, 2018). Effective risk mitigation measures, therefore, have to be designed as a more collective process that involves all stakeholders, promoting a more participative approach as requested by the EC Flood Directive.

Even if it is well known that feeling informed does not necessarily translate into the ability to adopt correct behavior during the emergency, it is certainly a critical fact that only one third of the respondents consider themselves to be informed, while 35% of this Tuscan sample claim to have little or no knowledge of the vulnerabilities and risks in the area where they live.

Although several respondents consider themselves poorly informed, 49% of them state they are prepared for flood risk. Confidence in personal ability to face risk is high and people who perceive themselves as well informed express a higher perceived preparedness. The link between RP/information and preparedness is ambiguous, as emerges in review studies (Bourque et al., 2013; Lechowska, 2018). While some authors find that RP is a strong predictor of behavior (Grothmann & Reusswig, 2006; Miceli et al., 2008), others deny the strength of this link (Siegrist & Gutscher, 2006; Steinführer & Kuhlicke, 2007). Being aware or informed of the risk of flooding is not a predictor of actual behavior, and preparedness may not be considered a direct output of awareness. Taking part in training may increase preparedness and facilitate communication and trust between individuals and authorities (Raska, 2015).

Being prepared implies knowing what to do in case of a flood. In our sample, more than half of the sample are unaware of the existence of a Local Emergency Plan and just 13% of the respondents are informed. The local Civil Protection Plan is a critical document with basic guidelines for flood risk management. The plan identifies safe areas and those that might be affected by floods, evacuation routes, and essential measures to follow to reduce hazard situations at the local level. Other studies have found that local communities are often unaware of the plan and its contents. In a survey conducted in Spain (Bodoque et al., 2016), only one-fifth of the sample knew where to go in order to be rescued by civil protection during a flood, and most of them overestimated their knowledge of the measures to take. These aspects should be considered when communicating the plan to citizens, who may not be interested or attentive because they overestimate their level of awareness.

Previous studies showed that protection from flooding is mainly seen as the responsibility of public authorities (Lara, Sauri, Ribas, & Pavon, 2010). This attitude influences individuals’ risk preparedness level (Lechowska, 2018; Seebauer & Babcicky, 2018; Terpstra & Gutteling, 2008). In particular, risk preparedness and attitude toward protective measures against damage were lower among people who attributed this responsibility to public authorities (Grothmann & Reusswig, 2006; Kellens et al., 2011; Lindell & Perry, 2000; Terpstra & Gutteling, 2008).

In this study, while only a few respondents attributed responsibility primarily or exclusively to themselves (13%), a large part of the sample (67%) believes that
responsibility for preparedness is equally distributed among institutions and citizens, revealing a willingness to undertake some personal action to cope with flood adversity. This attitude opens opportunities for a communication process that includes citizen participation as a key element in flood risk management, in a joint effort to increase the chances of success of society’s response to hazard events. Further efforts should be addressed toward increasing people’s awareness of the fact that protection against risks is first of all a personal responsibility. Individuals who believe this generally have a stronger tendency to take protective actions (Terpstra & Gutteling, 2008).

In this study, the self-declared level of information awareness about flood risk is positively correlated to personal responsibility. Responsibility in preparedness also showed a weak correlation with perceived preparedness. These results applied to the Tuscany population might suggest that, overall, Tuscany citizens are still unaware of their personal responsibility in managing flood risk and in taking preventive measures.

5 | CONCLUSIONS

The first aim of this study was to explore flood RP in Italy, with a focus on Tuscany, to gain useful insights for flood risk communication and management tailored to specific contexts. To examine RP, the authors investigated the relations among perceptions about flood risk, past experiences with flooding and some personal and “habitation” characteristics. The results generally support similar research studies on this topic, with some exceptions.

Respondents showed, in general, a moderate perception of flood risk. River proximity is the variable most strongly correlated with flood RP; also age and education affect perceived risk. Having previous flood experience seemed a strong component of RP, where both personal consequences and the magnitude of the flood event have the highest influence for those who had experienced a flood.

People living in the riskiest areas seem to be less aware of the objective flood risk of their area, and this is a big issue from the risk management point of view.

The analyses further revealed a tendency to attribute the damage and occurrence of flooding phenomena to inadequate public management. This attitude is related to a general distrust in proper management of the territory but does not influence the confidence in information provided by the Civil Protection and experts nor the belief in the improved capability in flood forecast and management.

Having a high-risk awareness does not necessarily imply being better prepared to tackle a future risk. It is also crucial to make people understand more clearly that they are firstly responsible for their protection even if the government puts in place all the necessary measures to prevent and manage flooding events.

The 2018 Report on hydrogeological instability in Italy, by the Italian Institute for Environmental Protection and Research (Trigila, Iadanza, Bussettini, & Lastoria, 2018) assess that Tuscany is one of the five regions with the highest levels of population at risk of flooding (considering the average hydraulic risk) with almost 1 million people potentially exposed (25% of the whole Tuscan population). It should be a matter of concern for emergency managers that citizens living in the most flood-prone areas are not conscious enough of the risk to which they are exposed. Communication campaigns should specifically address this issue, promoting capillary actions to make residents more aware that they are primarily responsible for their own security. According to our findings, the regional weather warning system is well established among the Tuscan population, and Civil Protection and experts are considered a reliable source of information. Future efforts could be aimed at promoting face-to-face training initiatives for people living in areas most exposed to flood risk, to increase their preparedness, and raise awareness of personal responsibility in managing and addressing risk.

Although we are aware that the results of this study may not be generalized to the whole Italian population, they could be useful to plan communication activities that consider the different targets involved and the specificity of the geographic dimension of risk so as to reduce local vulnerability and increase resilience of territories and communities.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.
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APPENDIX A.

Survey questions analyzed in this work.

Q1 Please select your age category.

a. under 18
b. 18–30
c. 31–50
d. 51–60
e. 61–70
f. 71–80
g. over 80

For the analysis, answers were grouped in fewer categories: categories from d) to g) where grouped into one option “over 51”.

Q2 What is the highest level of education you have completed?

a. secondary school
b. school-leaving certificate
c. university degree
d. PhD

For the analysis, answers were coded in new categories: a) was coded as “low”; b) was coded as “medium”; c) and d) were coded as “high”.

Q3 Are you male or female?

Q4/Q5 Please provide address (house number, street, town and post code) for the area in which you live.

Q6 Do you live in...

a. block of flats
b. single-family house

c. first floor

d. basement

Q7 Length of residence in current home in years

a. Less than 3 years
b. 4–10 years
c. 11–25 years
d. More than 26 years

c. second floor
d. third floor and over

Q8 Which floor do you live on?

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This item was turned into a dichotomic question assessing whether respondent lives at the ground floor: “yes” or “no”. Basement was considered in the same category of ground floor.

**Q9 Is the house near a river or creek?**
- less than 100 m.
- about 500 m.
- about 1 km.
- more than 1 km.
- Other:

**Q10 Are you (or your family) the owner of the house?**
- Yes
- No

**Q11 Have you experienced one or more flooding events in your life?**
- Yes
- No

**Q12 If yes, please indicate year, month, place of the flood...**
Answers to this item were coded into six categories:
1 = 0–3 years; 2 = 4–7 years; 3 = 8–19 years; 4 = 20–40 years; 5 > 40 years; NA.

**Q13 Did you suffered any damages? (Please select at most three options).**
- I did not get any damage.
- My relatives and/or acquaintances suffered damages.
- I suffered damages to other properties (cars, other vehicles, garages, various goods...)
- I suffered damages to my home.
- I suffered physical damage.

Options were coded in number, from 1 (a) to 5 (e).

**Q14 The episode caused: (yes, no).**
- Damages in your area.
- The interruption of some important road?
- The interruption of services (gas, electricity, water).

This item was used to derive magnitude of the flood. Answers were coded as: “0”, if no applied to all options; “1” if yes applied only to one option; “2” if yes applied to two; “3” if yes applied to all the three options.

**Q15 Could you indicate the type of feelings you experience now, when recalling what you experienced at that time?**
- I was scared for my life
- I was afraid for the lives of my family members
- I was afraid of incurring damage to my property
- I wasn’t scared

This item was coded as “Fear experienced” scored in descending order form 1 (d) to 4 (a).

**Q16 Do you know about the flood having occurred in Florence in 1966?**
Possible answers: (1) yes, (2) no (3), do not remember.

**Q19 Do you think today we would be able to predict an event like the 1966 one in advance?**
- Yes
- No
- I do not know

**Q20 How much do you feel exposed to each of these risks: traffic accident, fire, flood, landslide, earthquake, pollution, electromagnetic pollution, robbery, and terrorism.**
Possible answers:
(1) extremely exposed, (2) moderately exposed, (3) slightly exposed, (4) not at all exposed.

**Q22 In your opinion which is the flood risk of the area where you live?**
- null
- low
- medium
- high
- very high

Options were numbered in descending order, from 1 (a) to 4 (d). Options (d) and (e) were grouped in a single category numbered as (4).

**Q23 How likely do you find flooding in your home within the next 15 years?**
(Rate on a scale from 1 to 5, where 1 is no probability and 5 is a high probability).

**Q24 In case of flooding, do you think that you will suffer any damage?**
- Yes
- No

**Q25 Do you think that floods can be a real threat to your personal safety?**
- Yes
- No

**Q26 Why do you think flood events are dangerous for the community?**
- they are unpredictable
- there is a scarce presence of adequate protections (dams, embankments reinforcements, etc.)
• people adopt wrong behaviors
• there is bad management by local authorities

**Q27 What do you think would be the causes that could cause a flood in the area where you live?**
(Rate on a scale from 1 to 5, where 1 is no probability and 5 is a high probability).

• flooding of a major river
• breakage of the banks
• flooding of minor streams/rivers
• heavy rainfall
• sewer clogging

**Q28 In your opinion, what factors can contribute to a similar event?**
(Rate on a scale from 1 to 5, where 1 = Not Important, 2 = Slightly Important, 3 = Of Average Importance; 4 = Important, 5 = Very Important)

• incorrect management of the territory
• the lack of defense works (embankments, bridle ...)
• the characteristics of the soil
• overbuilding
• deforestation
• modification of the course of rivers and watercourses
• bad luck
• climate change
• little interest of public administrators

**Q29 How well informed do you feel about flood risk in your neighborhood?**
(Rate on a scale from 0 to 5, where 0 is not informed and 5 is very informed).

**Q31 Do you feel well prepared to face a flood event?**

a. Yes  
b. No  
c. Do not know

Answers were coded as follows: a) = 1; b) = 0; c) = 2.

**Q32 Has your municipality prepared an emergency plan?**

a) Yes, and I know it.

b) Yes, but I do not know it.

c) No, did not set it up.

d) I do not know.

Answers were coded as follows: a) = 3; b) = 1; c) = 2; d) = 0.

**Q33 Have you attended any training related to flood risk?**

• Yes  
• No

**Q35 How difficult is it to forecast where and when it will occur a flood?**
(Rate on a scale from 0 to 4, where 0 = very easy and 4 = extremely difficult)

**Q36 Compared to 1966, you think that today the management system of this type of risks is improved?**

• Yes  
• No  
• I do not know

**Q40 How much confidence do you have in the information on flood risk coming from:**
(Options: experts, technicians, scientists, emergency managers)
(Rate on a scale from 0 to 3, where 0 is “none at all”, 1 is “not very much”, 2 is “fair amount” and 3 is “great deal”)

**Q41 According to you, who is responsible for preparing you for flood disaster?**

a. I am completely
b. I am primarily
c. The government and I equally
d. The government is primarily
e. The government is completely

Options were grouped into three categories as follows:

1 = (d) and (e)
2 = (c)
3 = (a) and (b)
| Age groups | Press    | Level of Confidence |
|------------|----------|---------------------|
|            | none  | little | enough | much |
| under18    | 6%    | 37%    | 58%    | 0%   |
| 18-30      | 12%   | 38%    | 40%    | 10%  |
| 31-50      | 15%   | 38%    | 43%    | 4%   |
| over50     | 10%   | 41%    | 46%    | 4%   |
| Internet   |        |        |        |      |
| under18    | 8%    | 33%    | 56%    | 4%   |
| 18-30      | 6%    | 29%    | 52%    | 13%  |
| 31-50      | 9%    | 32%    | 49%    | 10%  |
| over50     | 5%    | 34%    | 50%    | 10%  |
| Environmental associations |        |        |        |      |
| under18    | 6%    | 35%    | 44%    | 15%  |
| 18-30      | 8%    | 40%    | 40%    | 12%  |
| 31-50      | 15%   | 32%    | 42%    | 11%  |
| over50     | 8%    | 33%    | 46%    | 13%  |
| Experts    |        |        |        |      |
| under18    | 2%    | 6%     | 46%    | 46%  |
| 18-30      | 0%    | 15%    | 38%    | 46%  |
| 31-50      | 5%    | 7%     | 46%    | 41%  |
| over50     | 1%    | 11%    | 45%    | 44%  |
| Emergency Managers |        |        |        |      |
| under18    | 0%    | 8%     | 38%    | 54%  |
| 18-30      | 0%    | 0%     | 44%    | 56%  |
| 31-50      | 2%    | 5%     | 33%    | 59%  |
| over50     | 1%    | 5%     | 33%    | 60%  |
| Police     |        |        |        |      |
| under18    | 4%    | 25%    | 35%    | 37%  |
| 18-30      | 8%    | 10%    | 40%    | 42%  |
| 31-50      | 3%    | 14%    | 45%    | 39%  |
| over50     | 3%    | 13%    | 44%    | 40%  |
| Local governors |        |        |        |      |
| under18    | 15%   | 23%    | 44%    | 17%  |
| 18-30      | 10%   | 38%    | 33%    | 19%  |
| 31-50      | 12%   | 31%    | 42%    | 15%  |
| over50     | 16%   | 34%    | 37%    | 12%  |
| Friends    |        |        |        |      |
| under18    | 8%    | 56%    | 37%    | 0%   |
| 18-30      | 10%   | 46%    | 42%    | 2%   |
| 31-50      | 13%   | 54%    | 27%    | 6%   |
| over50     | 14%   | 47%    | 32%    | 7%   |
| Elderly in my area |        |        |        |      |
| under18    | 15%   | 44%    | 35%    | 6%   |
| 18-30      | 23%   | 44%    | 25%    | 8%   |
| 31-50      | 20%   | 44%    | 30%    | 6%   |
| over50     | 24%   | 40%    | 25%    | 11%  |