

# Household Vulnerability and Preparedness for Disasters in Haiti

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## Abstract

This paper examines the socioeconomic factors correlated with vulnerability to natural hazards, using unique data from the High-Frequency Phone Surveys conducted in Haiti in 2021, 2022, and 2023. The results indicate a high overall exposure to hazards, with a significant number of individuals living in households facing the threat of multiple hazards. The analysis finds that disaster preparedness is generally low, with the poorest households experiencing the most significant challenges. Households in the bottom two wealth quintiles are less likely to have the necessary supplies to prepare adequately for and respond to disasters compared to those in the upper quintiles. Moreover, the level of

education of the household head and access to the internet are found to be correlated with the likelihood of having better disaster preparedness. This suggests that higher levels of education and internet access play a significant role in improving preparedness levels among households. Overall, these findings highlight the importance of addressing socioeconomic factors when developing strategies to enhance resilience to natural hazards. By focusing on improving disaster preparedness among the most vulnerable households and promoting education and internet access, policy makers can mitigate the negative impacts of natural disasters on affected communities.

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## Household Vulnerability to and Preparedness for Disasters in Haiti\*

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## 1. Introduction

Haiti's geographical location and preexisting fragilities make it particularly vulnerable to natural disasters. During the last decade alone, Haiti has suffered at least 44 natural hazards,<sup>6</sup> such as hurricanes and earthquakes, with the 2010 earthquake that killed an estimated 220,000 people standing out as the most devastating of them (Kolbe et al. 2010). At the same time, preexisting vulnerabilities, including a volatile and unstable political climate with high levels of violence and crime, limit disaster preparedness, response, and recovery. Prevailing socio-economic disparities may place certain population segments in disproportionate exposure to disasters. Limited resources at the household and community levels can limit the ability of a household to prepare for disasters, making poorer households more vulnerable. At the same time, natural disasters diminish the economic capacity of households, increasing vulnerability to future catastrophic events and thereby perpetuating a cycle of poverty. Kianersi et al. (2021) found that households severely affected by Hurricane Matthew in 2016 were more likely to be food insecure in the long term. Besides income, other socio-economic factors such as education, employment, and demographic characteristics, including age and gender, may exacerbate vulnerability conditions for marginalized populations (Llorente-Marrón et al. 2020a).

This paper uses data from a mobile phone survey carried out in 2021, 2022 and 2023 to examine socio-economic factors that may explain differences in household vulnerability to and preparedness for disasters. Understanding the risks households face, and their preparedness capacity is hampered by acute data shortages. Haiti's last national household survey, the "Enquête sur les Conditions de Vie des Ménages après Séisme" (ECVMAS), was conducted in 2012. To overcome this data gap, this note leverages mobile phone surveys carried out in July 2021, December 2021 and 2022, and March 2023.<sup>7</sup> While these surveys are useful to capture behaviors, and cost and time efficient, they also have limitations related to low response rates, a limited reach of respondents and a higher bias due to self-declaration. Despite these

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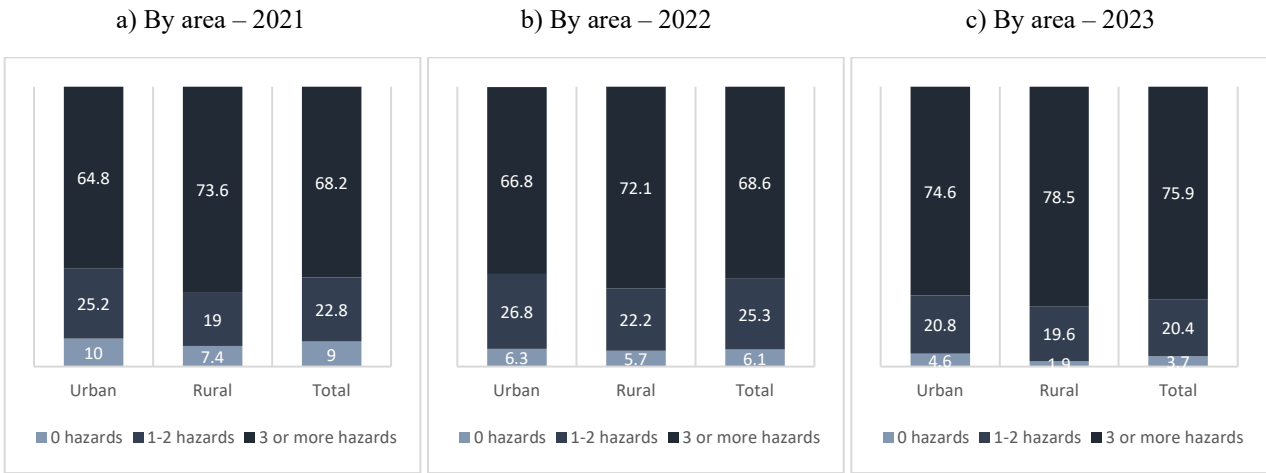
<sup>6</sup> <https://public.emdat.be/>

<sup>7</sup> The survey was part of the High Frequency Mobile Phone Surveys (HFS) implemented by the World Bank in several countries around the world to understand household welfare in the wake of the Covid-19 pandemic. This note uses data from the first and second waves of 2021, the third wave of 2022 and the fourth wave of 2023. The first wave of the survey included questions to estimate the wealth quintile of households (see methodological footnote on the creation of wealth quintiles below). The second, third and fourth waves of the survey included a Disaster Risk Module. A total of 2,631 households were interviewed in the second wave while 1,487 households were interviewed in both wave 1 (July 2 to August 5, 2021) and wave 2 (November 29 to December 22, 2021). For the third wave, a new sample of 1,530 respondents was interviewed (November 6 to December 11, 2022). Also, for the fourth wave, there were 1,532 new respondents. A more detailed description of the survey and the questions included can be found in the appendix.

limitations, phone surveys proved to be an important substitute for in-person surveys in contexts like Haiti, where in-person surveys are not suitable. Under these considerations, this paper contributes to the existing literature in at least three different ways. First, it documents households’ vulnerability to different types of natural disasters. Then access to and availability of community-level disaster preparedness mechanisms were analyzed. Lastly, the socioeconomic and demographic factors that are correlated with households’ preparedness for disasters in Haiti were investigated. Understanding these correlates can help inform public policies to support vulnerable households to become more resilient to natural disasters.

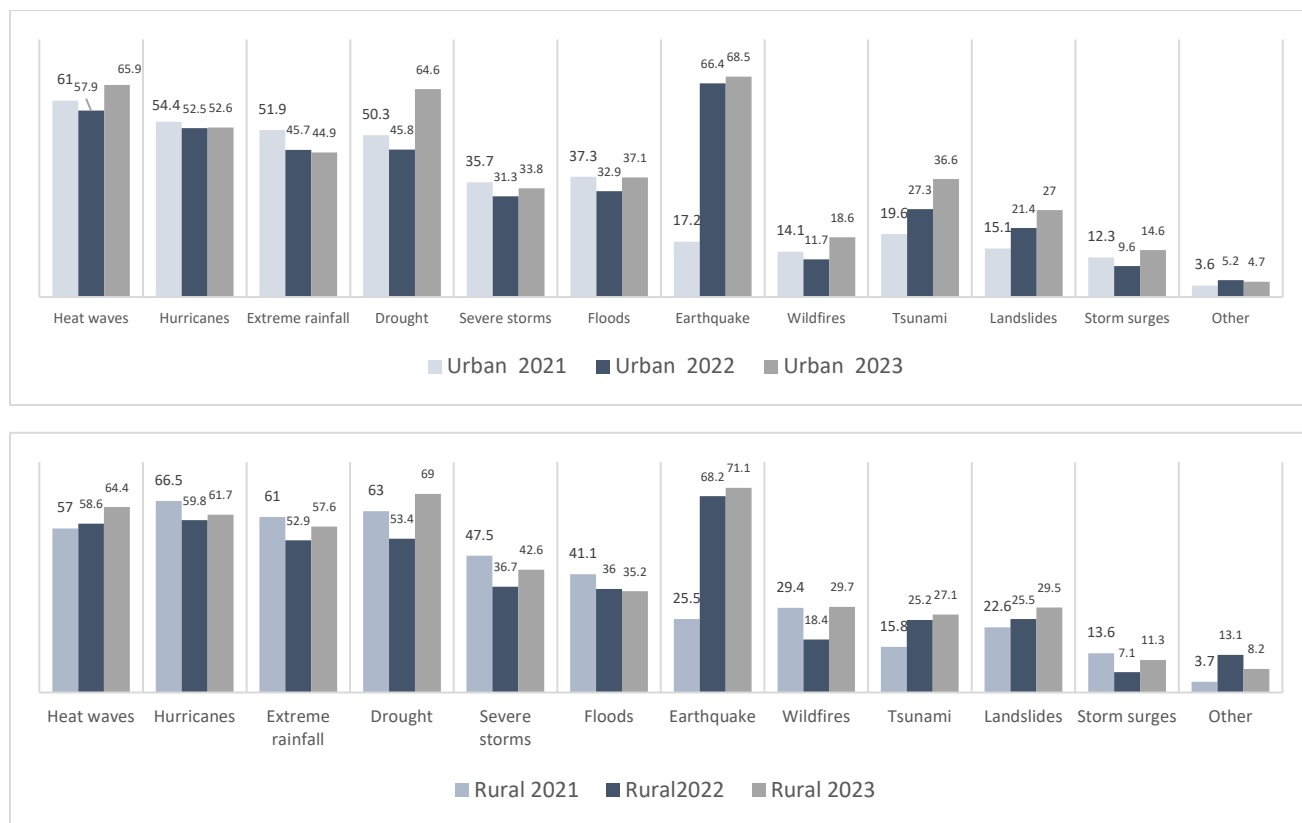
In Haiti, exposure to multi-hazards is high across the territory, and most individuals live in households exposed to three or more hazards. Results shows that 20 percent of respondents resided in households exposed to one to two hazards in 2023, while 76 percent resided in households exposed to three or more hazards, 7 percentage points more than in 2022 (Figure 1). Rural households reported higher exposure to three or more hazards than urban households in all survey years. The percentage of households reporting feeling threatened by earthquakes increased by nearly 50 percentage points by the end of 2022 compared to the end of 2021. Cyclones, heat waves, droughts and extreme rainfall are the hazards most reported by households in 2021, 2022 and 2023, with around 50 percent or more of respondents living in households threatened by each. Both urban and rural households face the same hazards in almost the same proportion, for example, earthquakes are the hazard that threatens in the highest proportion, but slightly higher in rural areas. Rural households are in higher risk of natural hazards than urban households (Figure 2).

**Figure 1: Number of hazards threatening households in urban and rural areas (% of respondents) – (2021-2023)**



Note: Results are from entire sample of wave 2, wave 3 and wave 4 households.

**Figure 2: Types of hazards threatening households in urban and rural areas (% of respondents) – (2021-2023)**



Note: Results are from entire sample of wave 2, wave 3 and wave 4 households.

Most natural hazards threaten in greater proportion those in the bottom poorest quintiles compared to households in richer quintiles. To examine whether exposure to hazards differs by socio-economic status, the data was disaggregated by household consumption quintile.<sup>8</sup> By the end of 2022 and by early 2023 a larger share of individuals in the poorest two quintiles reported facing threats to most natural hazards compared to those in the middle- and high-consumption quintiles (Table 1). For example, while 75 percent of individuals in the bottom quintiles reported living in a household exposed to earthquakes, this was

<sup>8</sup> The SWIFT methodology was used to simulate consumption expenditure. Specifically, wave 1 of the HFS (collected in July-August 2021) included questions on poverty correlates to distinguish relatively poorer households from relatively richer households. These questions were drafted following Haiti’s ECVMAS 2012 household survey and were then used to predict the position of respondent’s household in the consumption distribution and to subsequently create wealth quintiles. To assign wealth quintiles to households in the wave 2 data, we restrict the sample to the panel of households that were interviewed in both rounds 1 and 2 and we assume that households maintained their quintile position in wave 2. Using this approach, of the 2,361 observations in wave 2 only 1,487 observations were panel and could be assigned the consumption quintile. For this and subsequent sections where data from wave 2 is disaggregated by quintile, the sample is restricted to only these panel households. Given that all observations in wave 3 and wave 4 were new, we applied the same methodology used for wave 1 data, to assign wealth quintiles to the households. Out of a total of 1,530 observations in the wave 3 data we could assign wealth quintiles to 1,529 households. Data disaggregated in this note by consumption quintile for wave 3 refers to these 1,529 observations. For the fourth round, consumption quintiles were assigned to all 1,532 observations.

lower at 65 percent among those in middle- and high-consumption households in early 2023. Furthermore, households in the poorest consumption quintiles reported higher exposure to natural hazards in 2022 and 2023 compared to that reported at the end of 2021.

Households in the two poorer quintiles reported greater vulnerability to other types of natural hazards in 2022 and 2023 compared to middle- and high-consumption households. The gap between households in these two categories of consumption quintiles that reported a threat from heat waves, hurricanes, extreme rainfall, and drought widened by the end of 2022 and early 2023 and became statistically significant (Table 1). By this period, households in the two bottom quintiles were more likely to be threatened by these natural hazards than those in the three upper remaining quintiles, reporting a statistically significant difference of at least 6 percentage points. Although, by the end of 2022, the proportion of households that reported feeling threatened by severe storms and floods decreased, this change was higher for middle- and high-consumption households, and the gap widened by about 10 percentage points, remaining so until 2023.

**Table 1: Self-reporting of the types of natural hazards threatening households by consumption quintile groups (2021-2023)**

Type of hazard	2021			2022			2023		
	Bottom 40 percent (mean)	Top 60 percent (mean)	Difference	Bottom 40 percent (mean)	Top 60 percent (mean)	Difference	Bottom 40 percent (mean)	Top 60 percent (mean)	Difference
Heat waves	0.5779	0.5821	-.0042	.6033	.5645	.0388	.6880	.6278	.0602**
Tropical cyclones/Hurricanes	0.6157	0.5836	.0321	.6442	.4760	.1682***	.6479	.4859	.1620***
Extreme rainfall	0.5876	0.5456	.0420	.5690	.4134	.1555***	.5978	.4089	.1888***
Drought	0.5444	0.5224	.0219	.5627	.4219	.1408***	.7432	.5970	.1461***
Severe storms	0.4359	0.3805	.0554*	.3981	.2794	.1187***	.4347	.3148	.1199***
Floods	0.4144	0.3593	.0550*	.3938	.2971	.0967***	.4166	.3248	.0918***
Earthquake	0.2511	0.1700	.0811***	.7027	.6435	.0593**	.7497	.6501	.0996***
Wildfires	0.2360	0.1699	.0660**	.1771	.1106	.0664***	.2843	.1759	.1085***
Tsunami	0.1950	0.1522	.0427*	.3001	.2390	.0610**	.3525	.3200	.0326
Landslides	0.2164	0.1503	.0661***	.2595	.2038	.0557**	.3334	.2362	.0972***
Storm surges	0.1411	0.0975	.0436**	.1116	.0688	.0428**	.1522	.1220	.0302
Other	0.0337	0.0326	.0011	.0653	.0938	-.0285	.0864	.0337	.0527*

Note: 1) Tests of significance with robust standard errors comparing means between groups are reported \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. 2) Bottom 40 percent refers to the bottom first two quintiles, while the Top 60 percent refers to the remaining upper three quintiles. 3) Results for 2021 are from the sub-sample of 1,487 households that were panel and for which consumption quintiles could be estimated. 4) Results for 2022 are from the 1,529 observations for which income quintiles could be assigned. 5) Results for 2023 are from entire sample of wave 4. See the methodological footnote above on the creation of consumption quintiles.

Rural households are more exposed to natural hazard than urban households, and this is exacerbated for rural households in the lowest quintiles. Urban households in the middle- and high-consumption households are in less risk for natural hazards (Table 5, appendix A1). In this context, comparing the

poorest households between urban and rural areas, several natural hazards threaten in higher proportion according to the respondents. For instance, hurricanes threaten 74 percent of rural and poor households, while only a 59 percent for urban and poor households, almost 15 percent higher. Likewise, vulnerability at the household level is also higher among households with a less educated head of household. Given the correlation between socio-economic status and education, the data by educational level of the household head was disaggregated to examine the vulnerability of households to natural hazards. Results show that certain natural hazards affect in higher proportion those with a lower level of education of the household's head. For instance, 61 percent of respondents that reported an educational level of the head of household equal to primary school or less reported living in a household exposed to cyclones, compared to 55 percent for those with heads of household with more than primary education (Table 6).

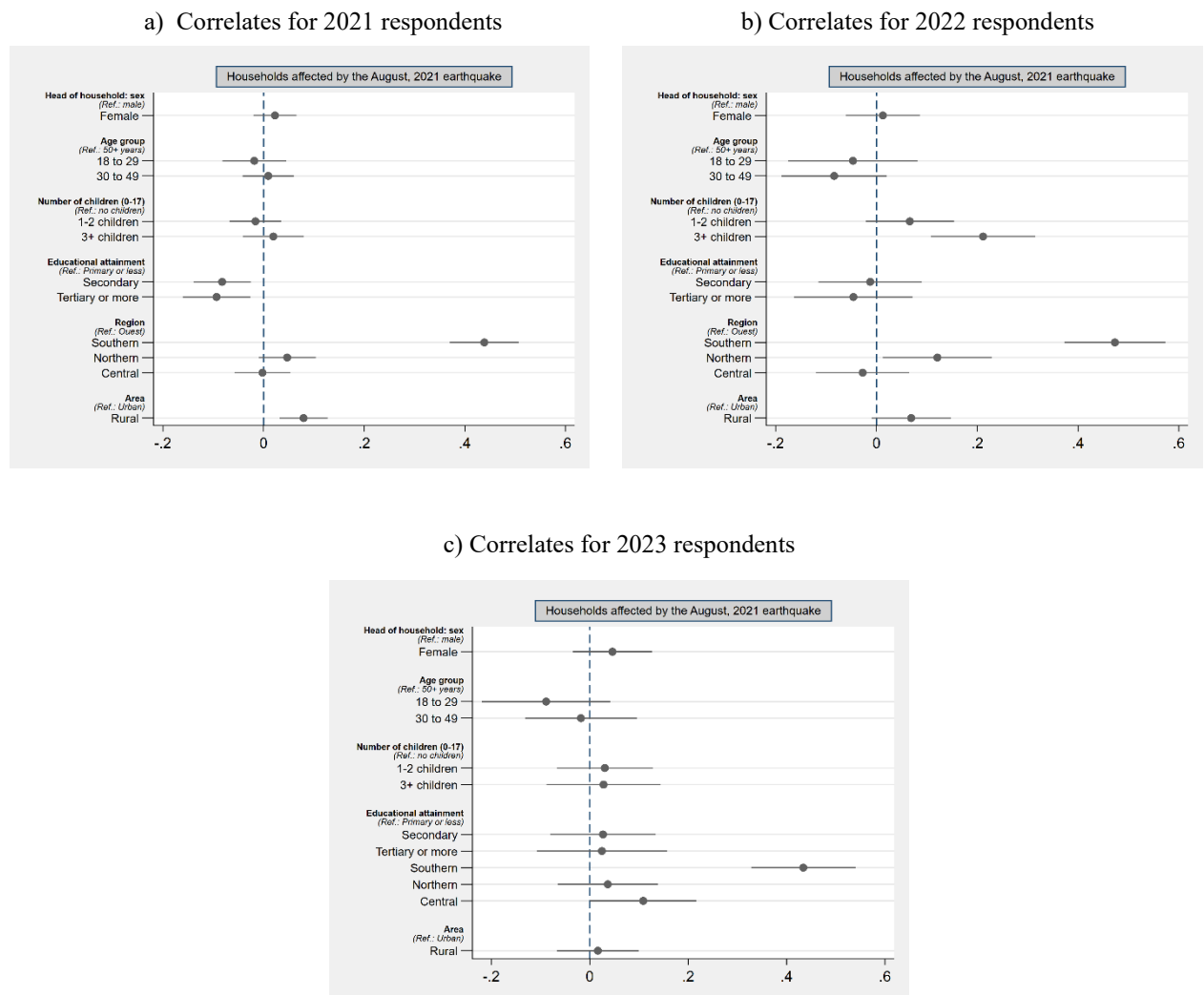
For earthquakes, data from the most recent earthquake on August 14, 2021, suggests that the educational level of the household head and the presence of children in the household correlate with the likelihood of being affected. In 2021, Haiti experienced an earthquake that resulted in 2,246 deaths, 12,673 injured and the destruction of infrastructure, with an estimated \$1.6 billion in damage and losses.<sup>9</sup> We examine which socioeconomic factors are correlated with being affected by the earthquake in a multivariate regression framework. The results show that the households in the southern region are more likely to report being affected in all survey years, as expected, since the earthquake hit the southern peninsula of the country. The results in Figure 3a show that households where the household head has an educational level of secondary or tertiary or more decreases the chances by 9 and 10 percentage points of being affected by the earthquake, respectively; while living in rural area increases the likelihood of suffering from this hazard. The multivariate analysis for 2022 shows that households with 3 or more children have a higher probability of being vulnerable to earthquakes (by 22 percentage points). Additionally, there are no statistically significant differences by sex of head in reporting impacts from the earthquake. However, the absence of differences by sex of household head does not imply the absence of gender differences in impact given that this variable does not capture within-household gender differences.

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<sup>9</sup> <https://www.worldbank.org/en/country/haiti/overview>



**Figure 3: Examining correlates of whether a household was affected by the 2021 earthquake (2021-2023)**

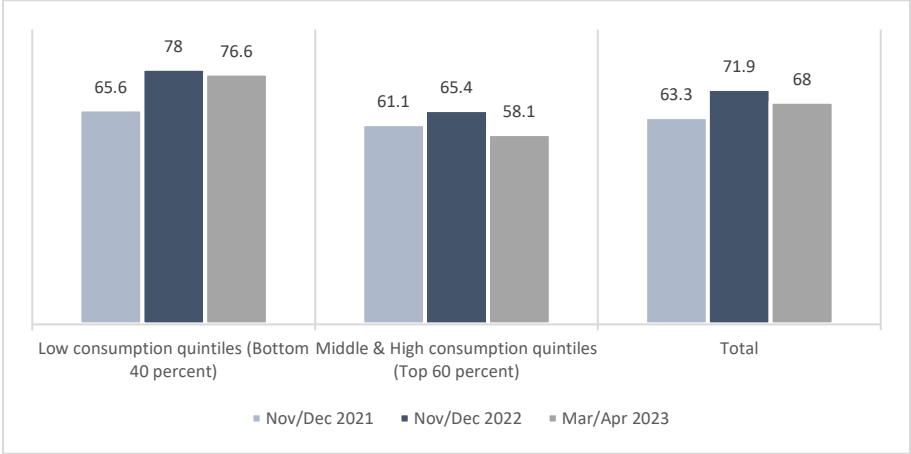


Note: 1) Results from the full sample of wave 2, wave 3 and wave 4 households. 2) Consumption quintile group is not used as a control variable since it is constructed from household characteristics included in the regression (region and head of household sex, age, educational attainment) and hence correlated with these variables. 3) The variables for educational level and age group refer to these characteristics of the head of the household.

The households in the southern region that were most affected by the 2021 earthquake were those in the bottom quintiles. By early 2023, 68 percent of households reported being affected by this natural disaster (Figure 4). The households in the two poorer quintiles were more likely to be affected than those in the middle- and high-consumption quintiles with a statistically significant difference of almost 19 percentage points (77 percent vs. 58 percent). This difference was only 4 percentage points at the end of 2021 and was not statistically significant, which may suggest a cumulative impact for the most vulnerable households. By 2023, a quarter of the poorest households were in the southern region of the country (Figure 5a). Ouest was the region that showed the greatest proportion of households in the middle- or

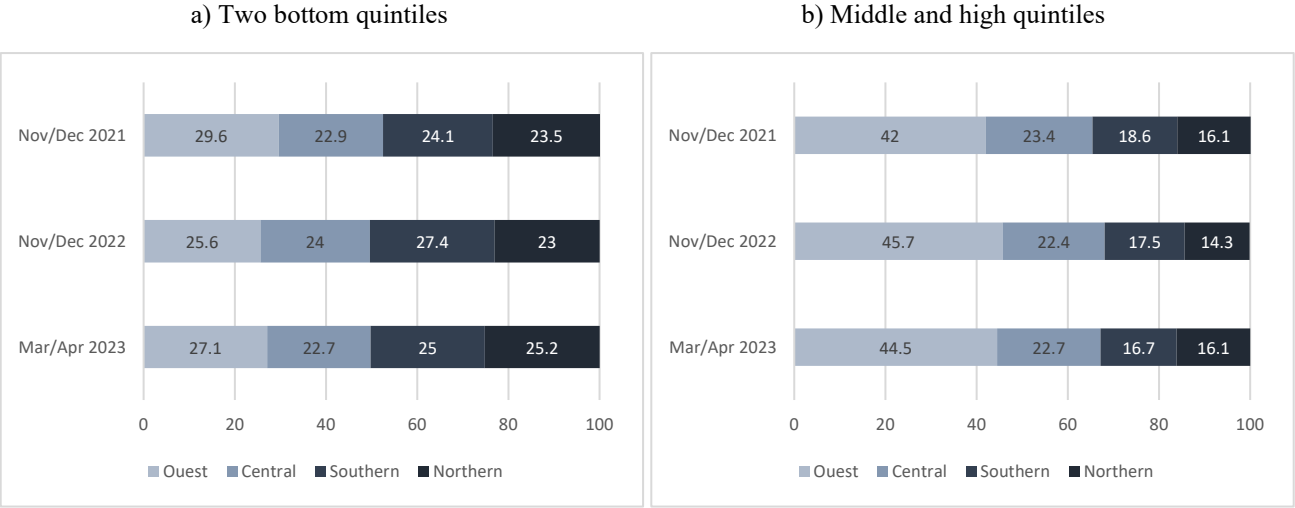
upper-consumption quintiles (44.5 percent), while in the southern region this figure corresponded to only 16.7 percent (Figure 5b). Households in the lowest consumption quintiles are more likely to be less prepared to face a natural disaster (see section 4), which shows the particular vulnerability of this area of the country to the August 2021 earthquake.

**Figure 4: Percentage of households in the southern region affected by the 2021 earthquake according to consumption quintile groups (2021-2023)**



Note: Results for 2021 are from the sub-sample of 1,487 households that were panel and for which consumption quintiles could be estimated. Results for 2022 are from the 1,529 observations for which income quintiles could be assigned. Results for 2023 are from entire sample of wave 4.

**Figure 5: Percentage distribution of households in the two bottom and the middle -and high-consumption quintiles by region (2021-2023)**



Note: Results for 2021 are from the sub-sample of 1,487 households that were panel and for which consumption quintiles could be estimated. Results for 2022 are from the 1,529 observations for which income quintiles could be assigned. Results for 2023 are from entire sample of wave 4.

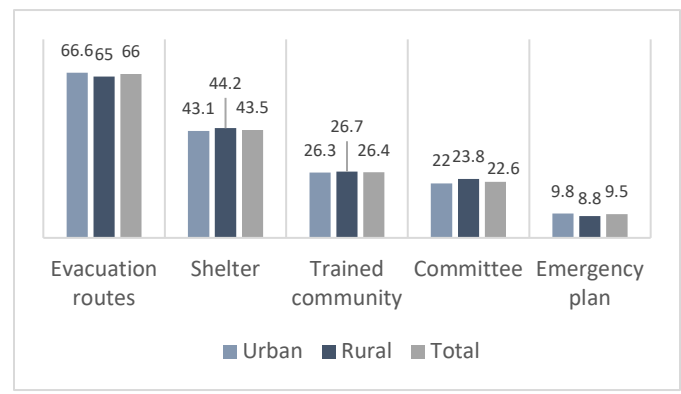
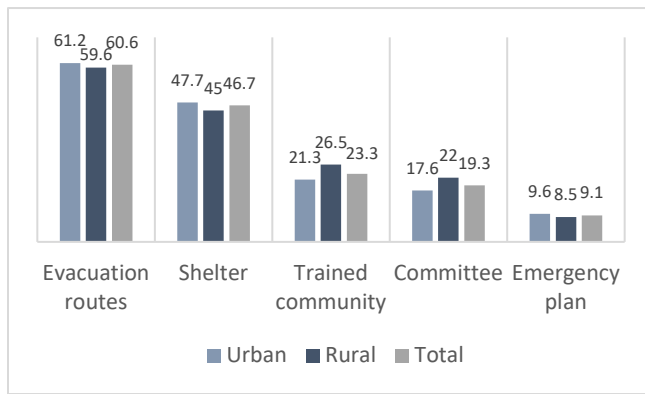
## 2. Access to community-level disaster preparedness mechanisms

Most households live in communities where communal-level preparedness is low. By the end of 2021, only 9 percent of households had access to an emergency plan, and less than 25 percent of households had committees or community-trained members for disaster response (Figure 6a). The most common, but still scarce community coping mechanisms, were the evacuation routes (61 percent) and emergency shelters<sup>10</sup> (47 percent). Between the end of 2021 and early 2023 there was an increase of at least 2 percentage points in the proportion of households that reported having access to all community coping mechanisms except for shelters, with a 2-percentage-point drop (Figure 6). Nevertheless, rural households are less prepared than urban households for some mechanisms. Even though the difference is often less than 5 percentage points, in 2023, this gap is closed, and rural households show a better level of preparation than in previous years.

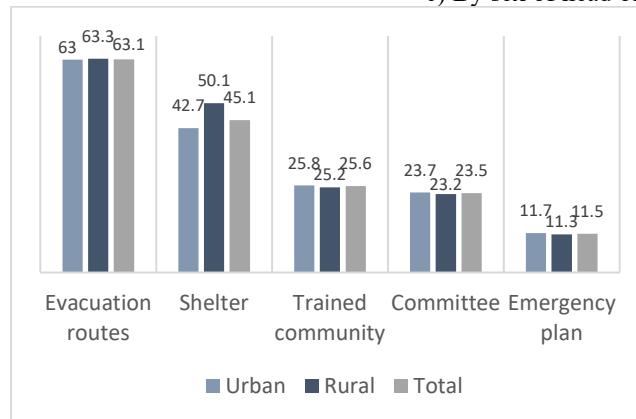
**Figure 6: Community disaster mechanisms by household’s area of residence (%) – (2021-2023)**

a) By sex of head of household (2021)

b) By sex of head of household (2022)



c) By sex of head of household (2023)

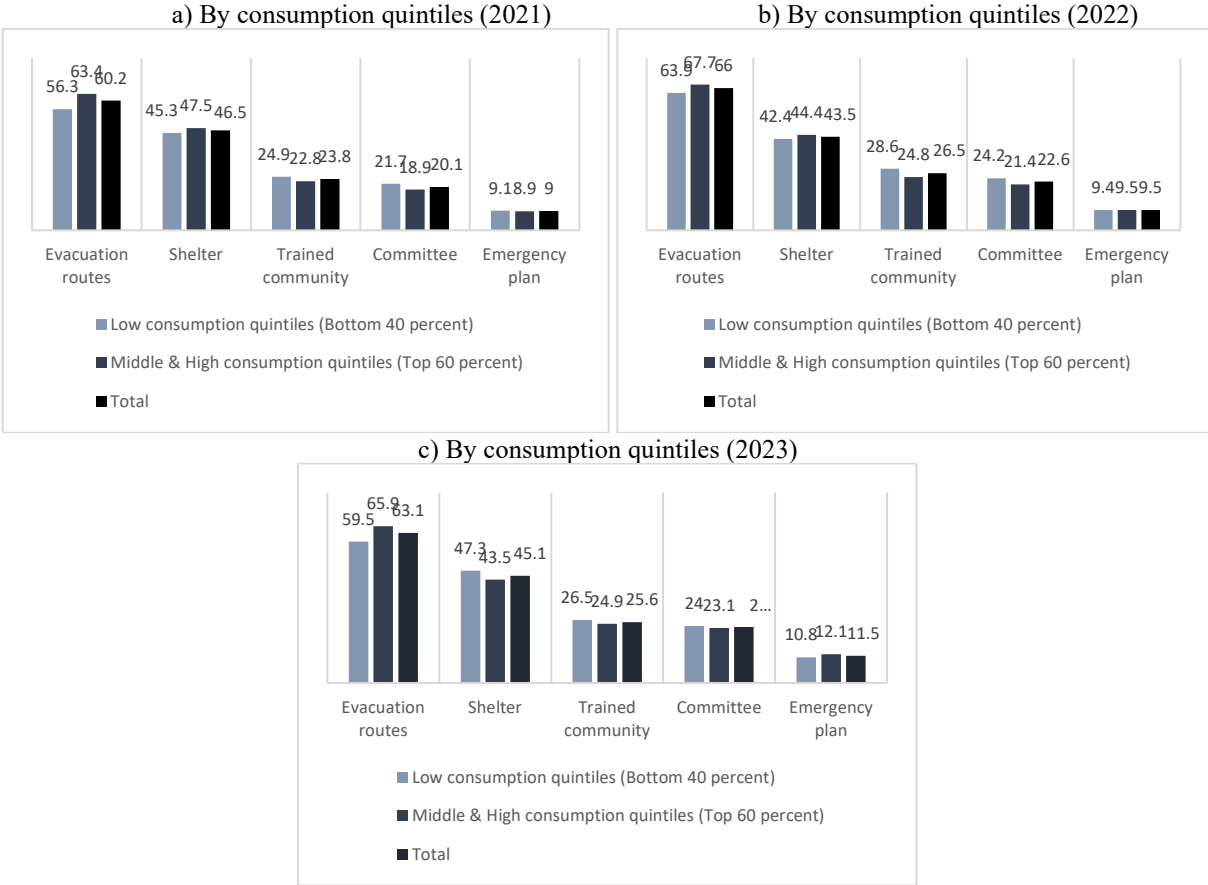


Note a): Results from the full sample of wave 2. Note b): Results from the full sample of wave 3. Note c): Results from the full sample of wave 4.

<sup>10</sup> Subsequently referred to as shelter.

Differences by socioeconomic status (i.e., consumption quintiles) in community coping mechanisms are not statistically significant except for evacuation routes by the end of 2021 and early 2023. The proportion of households with access to evacuation routes in the poorest quintiles was 6 percentage points lower than those in the middle- and high-consumption quintiles in 2023 (Figure 7c). By the end of 2022, a higher proportion of households had access to evacuation routes regardless of the consumption quintiles of households (Figure 7b). Following evacuation routes, shelters are the mechanism most available to households in the community. By early 2023, 45 percent of households reported an identified shelter to go to in the event of a natural disaster. This proportion was higher for households in the two bottom consumption quintiles than for those in the middle or higher quintiles (47 percent vs. 43 percent). These gaps were not statistically significant.

**Figure 7: Community disaster mechanisms by consumption quintiles (%) – (2021-2023)**



Note a): Results from the sub-sample of 1,487 households that were panel and for which consumption quintiles could be estimated. Note b): Results for 2022 are from the 1,529 observations for which income quintiles could be assigned. Note c): Results for 2023 are from entire sample of wave 4.

Female-headed households were more likely to report poor community preparedness for natural disasters compared to male-headed households, while urban and rural households are almost equally prepared. By 2023, the most pronounced differences between male- and female-headed households in access to all community coping mechanisms were concentrated in access to shelter and community training to help others during a natural disaster (Table 2). In the first case, almost half of male heads of household surveyed reported access to shelters in their community while the proportion of female-headed households was 41 percent. Second, male heads of household were more likely than female heads of household to live in communities with members trained to help amid a disaster (28 percent vs. 23 percent). The difference between male-headed and female-headed households that reported accessing all other mechanisms was about 2 percentage points, yet not statistically significant. While access to shelter shows a higher difference between urban and rural households (7 percentage points).

**Table 2: Access to coping mechanisms within the community by sex of household head and area of residence – 2023**

	Overall	Male (mean)	Female (mean)	Difference	Urban (mean)	Rural (mean)	Difference
Evacuation routes	.6312	.6413	.6182	-.0231	0.63	0.63	0.00
Shelter	.4515	.4859	.4069	-.0790***	0.43	0.50	0.07**
Trained community	.2557	.2787	.2259	-.0528**	0.26	0.25	-0.01
Committee	.2351	.2474	.2192	-.0283	0.24	0.23	0.00
Emergency plan	.1154	.1250	.1029	-.0221	0.12	0.11	0.00

Note: 1) Tests of significance with robust standard errors comparing means between groups are reported \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. 2) Results are from the full sample of wave 4 households.

The results are consistent with existing evaluations that found gaps in the social vulnerability associated with natural disaster preparedness and response. Llorente-Marrón et al. (2020a) found an increased gender gap associated with household social vulnerability after the Haiti earthquake in 2010, leading to a lower preparedness and response capacity of female-headed households. The authors highlighted the need for national and local disaster preparedness and mitigation programs that involve the community, address the gender gap, and empower women. In addition, Ndambuki and Al Hitmi (2021) found that although Haiti has a national disaster evacuation and transportation plan, the implementation of these plans has been deficient. For this reason, the authors recommend the diversification of means of transportation in the places most vulnerable and exposed to natural hazards and strategies for coordinating the effective response of transportation systems.

In addition, a case study by Rahill et al. (2014) could indicate that after a natural disaster occurs, not all those affected have access to the same shelter-related resources. The authors analyzed the role of social capital in the temporary access to shelters of the displaced population in three socioeconomically different communities (Pétion-Ville, Delmas, and Canapé Vert) in Port-au-Prince after the earthquake of January 12, 2010. The authors found that social capital plays a very relevant role in access to shelters and shelter-related resources in a context where the government cannot provide for all shelter needs. Assistance to some of those who were displaced by the catastrophe – for example, those displaced from higher social classes – improved through social capital due to connections with aid agencies. Displaced Haitians with better connections accessed improved shelter facilities and shelter-related resources, such as tents or tarps, at the expense of other excluded displaced Haitians with fewer connections, accentuating and creating new inequalities among displaced people.

### **3. Household-level preparedness**

Preparedness at the household level is low and more so among the poorest households. Nearly 80 percent of households in Haiti mentioned being unprepared to face a disaster by early 2023 (Table 3). The households in the poorest quintiles reported lower preparedness rates (10 percentage points lower). Although around 55 percent of households, regardless of socioeconomic status, discuss with family members what to do in the face of a disaster, only 20 percent of households in the richest quintiles have supplies to respond to a disaster. The proportion of households in the poorest quintiles with these tools is even lower, at only 7 percent. The differences in preparedness by socioeconomic status became wider between 2021 and 2023. While the share of households in the middle- and high-consumption quintiles with disaster-coping tools rose to 20 percent (5 percentage points higher than at the end of 2021), the households in the two bottom quintiles decreased their share at 7 percent (Table 4). By 2023, 85 percent of the households in the two poorer quintiles were unprepared to face a natural disaster, 10 percentage points more than reported by the households in the upper three quintiles and a gap 2 percentage points wider than reported at the end of 2022. Likewise, households in the bottom of the consumption quintiles were more likely than households in the middle- and high-consumption quintiles to be less prepared to face a natural hazard in relation to the pandemic by a difference of 11 percentage points (3 percentage points wider than at the end of 2021).

The difference in preparedness narrows between urban and rural households and several are not statically significant, indicating similar levels of preparedness in 2022 and 2023. The difference yields mostly in 2021, households with supplies are a bit different between urban and rural households, but this differences decreases for the next years. However, households’ residence is not important in their reports on whether they are prepared currently for facing a disaster or not, with less 1 percent of difference, 77 percent of respondents report that they are not currently prepared to face a disaster in 2022 for both urban and rural areas and in 2023 this was 79 percent in both areas, showing a slight increase in this category.

**Table 3: Level of preparation within the household to cope with a disaster by consumption quintile groups and residence area (2021-2023)**

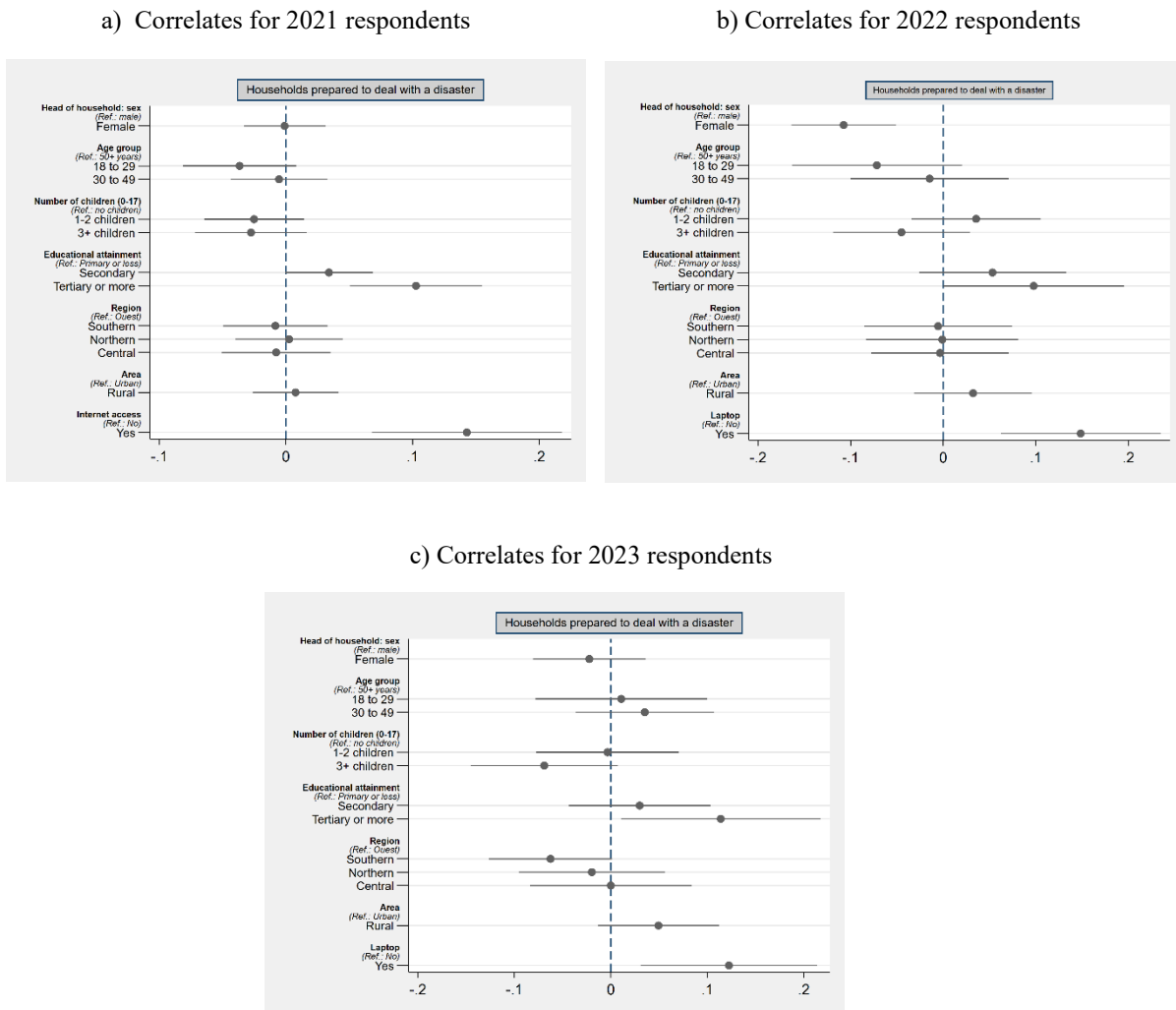
	Quintile Groups												
	2021				2022				2023				
	Overall consumption quintiles	Bottom 40 percent (mean)	Top 60 percent (mean)	Difference	Overall consumption quintiles	Bottom 40 percent (mean)	Top 60 percent (mean)	Difference	Overall consumption quintiles	Bottom 40 percent (mean)	Top 60 percent (mean)	Difference	
Household with supplies	.1236	.0914	.1493	-.0580***	.1434	.0925	.1832	-.0907***	.1452	.0749	.1994	-.1244***	
The family talked about what you would do in a disaster	.4964	.5166	.4802	.0363	.5643	.5620	.5662	-.0042	.5576	.5514	.5625	-.0111	
Currently not prepared to respond to a disaster	.8442	.8697	.8238	.0459**	.7738	.8222	.7360	.0863***	.7900	.8473	.7458	.1015***	
Less prepared compared to pre-pandemic	.6645	.7114	.6269	.0846***	.7283	.7864	.6830	.1033***	.7095	.7716	.6617	.1098***	
	Residence Area												
	Overall	Urban (mean)	Rural (mean)	Difference	Overall	Urban (mean)	Rural (mean)	Difference	Overall	Urban (mean)	Rural (mean)	Difference	
	Household with supplies	0.1236	0.1357	0.0822	-0.053***	0.1434	0.15064	0.12886	-0.02179	0.1452	0.1440	0.1475	0.0035
	The family talked about what you would do in a disaster	0.4964	0.5011	0.5150	0.0139**	0.5643	0.57132	0.54990	-0.02142	0.5576	0.5452	0.5827	0.0376
	Currently not prepared to respond to a disaster	0.8442	0.8270	0.8615	0.0345	0.7738	0.77206	0.77637	0.00431**	0.79	0.7883	0.7935	0.0053
Less prepared compared to pre-pandemic	0.6645	0.6285	0.6645	0.0361	0.7283	0.71003	0.76358	0.05356	0.7095	0.6922	0.7443	0.0521*	

Note: 1) Tests of significance with robust standard errors comparing means between groups are reported \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. 2) Bottom 40 percent refers to the bottom first two quintiles while Top 60 percent refers to the remaining upper three quintiles. 3) Results are from the sub-sample of 1,487 households that were panel and for which consumption quintile could be estimated. 4) Results for 2022 are from the 1,529 observations for which income quintiles could be assigned. 5) Results for 2023 are from entire sample of wave 4. See the methodological footnote above on the creation of wealth quintiles.

Besides consumption, the level of preparedness within households may be correlated with different sociodemographic characteristics. We explore which factors are correlated with being prepared using a

multivariate regression framework. After controlling for other factors that might be related to the level of household disaster preparedness, results show that the educational level of the household head of tertiary education or more increases the probability of the household being prepared to cope with a disaster by 10 percentage points (Figure 8a). Furthermore, access to the internet or having a laptop increases the chances of being prepared for a natural disaster by 14 percentage points (Figure 8a, Figure 8b and Figure 8c). On the contrary, female headed households are less likely to be prepared for a disaster by 10 percentage points (Figure 8b).

**Figure 8: Examining correlates of whether a household was prepared to cope with a disaster (2021-2023)**



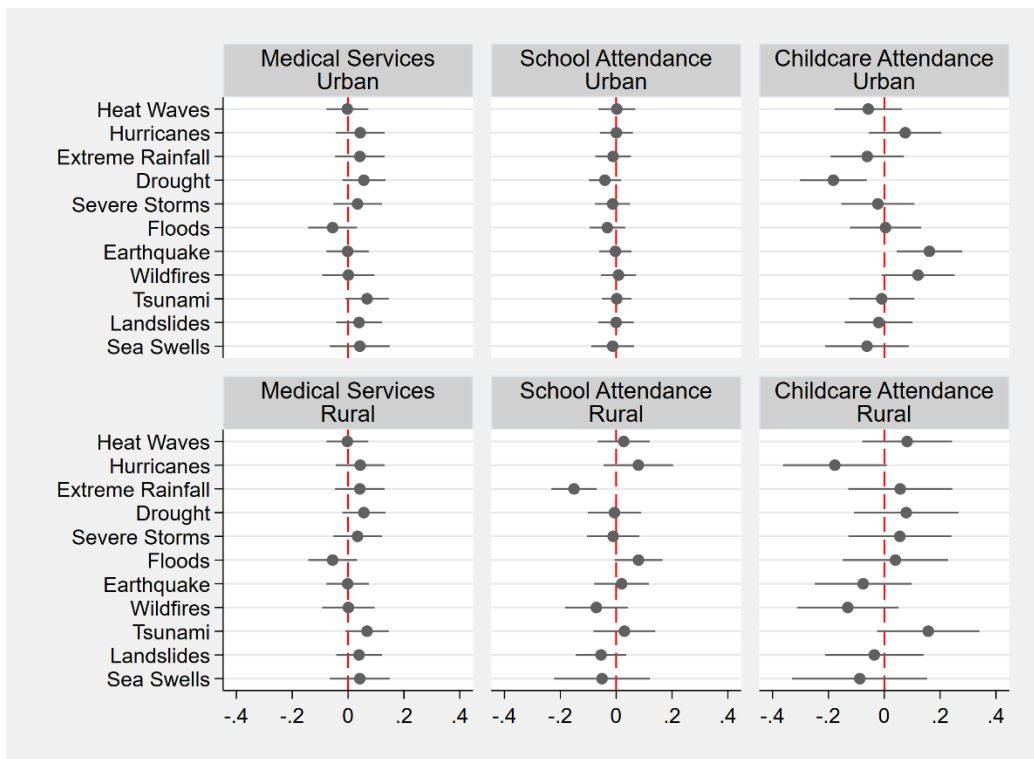
Note: Results from the full sample of wave 2, wave 3 and wave 4 households. The consumption group is not used as a control variable since it is constructed from household characteristics included in the regression (region and head of household sex, age, educational attainment) and hence correlated with these variables. The variable prepared includes the answers of respondents that consider that at the time of the survey, their households were very prepared or somewhat prepared to cope with a disaster.



#### 4. Natural disasters and household outcomes in education and health

The likelihood of the need for medical services slightly increases when households face natural hazards in both rural and urban areas. Even though the households and their relationships with natural disasters vary according to some socioeconomic characteristics, these hazards can affect their access to basic services, such as health and education. However, the correlation between these two dimensions is statistically not significant (Figure 9), the effect of natural hazards on the need medical attention is positive, meaning that households threatened by natural hazards will have greater urgency in accessing health care services than households that are not facing these warnings. This result does not differ between urban and rural households.

**Figure 9: Education and Health access correlation with natural hazards, by area of residence. (2023)**



Extreme rainfall decreases the chances of school attendance for rural households and childcare attendance declines when households face droughts in urban areas. Observing how natural hazards affect households' children's school attendance, most of these have a greater effect on rural areas than urban areas, indicating that when a natural disaster occurs, rural children's school attendance might be lower than that of urban children. While the effects are slightly less evident in both areas, droughts affect more households in urban

areas than rural, decreasing by almost 20 percent the likelihood of childcare attendance for the youngest members of the household.

## 5. Conclusions

Overall, the findings in this note point to the need for improving disaster preparedness and prevention. While the high levels of vulnerability suggest that a majority of households across the country require support, the poorest households face heightened vulnerability. Examining differences by socioeconomic status, evacuation routes were significantly lower in the poorest quintiles compared to middle- and high-consumption quintiles by 6 percentage points in 2023. Nevertheless, by late 2022, a higher proportion of households had access to evacuation routes across all consumption quintiles. Shelter access, a crucial mechanism, showed a higher proportion for the two bottom consumption quintiles compared to the middle or higher quintiles (47% vs. 43%). Gender-based disparities were evident, with female-headed households reporting poorer community preparedness. In 2023, the most pronounced differences were observed in shelter access and community training. Male heads were more likely to report access to shelters (48%) compared to female-headed households (41%), emphasizing the gender gap. Male-headed households were also more likely to live in communities with disaster-trained members (28% vs. 23%). Other mechanisms showed a smaller, statistically insignificant difference. These disparities were not statistically significant, indicating an overall improvement.

The low level of preparedness suggests that sensitization of households could better prepare households for natural disasters. Moreover, the findings underscore the urgency of addressing gender disparities, socioeconomic factors, and enhancing community-level disaster preparedness programs in Haiti to mitigate the impact of natural disasters on vulnerable households. This requires to be accompanied by response plans that reach the most vulnerable in receiving warnings or information on preparedness and emergency goods and the joint work of national and local government, the private sector, and civil society organizations (Marcelin et al., 2016). Programs such as the World Bank's Strengthening Disaster Risk Management and Climate Resilience (PGRAC) project, aiming to improve the resilience of the Haitian population against hydrometeorological hazards through the financing of infrastructure investments and the provision of technical assistance in high climate risk-prone municipalities and vulnerable population areas, can be useful tools when facing the challenges outlined in this paper. One of the main gaps in preparedness and response to these natural hazards is the lack of adequate emergency shelters for the

population at risk. To address this gap, extending the network of adequate emergency shelters that also provide basic emergency needs such as food, water, and first aid is of prime importance (World Bank, 2019).

In addition, given evidence from existing studies that the negative effects of the 2010 earthquake further intensified for female-headed households, efforts to incorporate gender awareness into disaster risk prevention and mitigation are necessary (Llorente-Marrón et al. 2020b). For example, the PGRAC project also recommends the adoption of safer construction practices to mitigate the damage to which public and private buildings would be exposed in the event of an earthquake and therefore promotes the expansion and communication of safe construction practices. The correlation of internet access and education with disaster preparedness also suggests that digital access may help in the preparedness of households.<sup>11</sup> Although improving disaster preparedness, response and recovery in Haiti are complicated by the unstable political climate; it is a challenge that is ever more pressing and will require a concerted effort to tailor interventions to the country's fragile political and economic context.

While we presented evidence on the vulnerability of households to shocks in Haiti, further research is needed to address the channels and heterogeneity of these effects. Focusing on gender gaps and understanding the underlying reasons for their low preparedness and response can draw important results to incorporate better targeted policies. Another point to investigate in the future is related to the political climate. Incorporating this situation according to the conflict by region can show different results in preparedness and response of the households for facing natural disasters in Haiti.

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<sup>11</sup> Evidence on information and communications technologies in natural disaster management in Africa suggested that internet access reduces the negative effects of natural disasters such as droughts and floods through awareness and education of people as aid and assistance in case of a catastrophe (Djournessi and Mbongo, 2022).

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## APPENDIX

### A1. Survey sampling information

The sample of the survey covers all individuals who have access to an active cellphone in Haiti. The survey includes individuals 18 years old or older in households that at least have one cell phone number at home. The universe from which the sample is chosen first covers all the cell phone numbers under the national telephone information. Once the cell phone numbers were identified, the second stage of sampling includes selecting actives number of the entire list of numbers. A final stage corresponds to a cross-checked stage where the numbers were identified with business registries. Finally, a random selection of numbers was performed and then provided to the interviewers and fieldwork teams. It is important to highlight that the survey has two sample units: households and individuals. Sometimes households can have more than one cellphone number, this was considered in the sampling to eliminate over-representation on the final sample. The survey was carried out by cell phone calls in each wave. Once someone answered the call, the interview started with the questions of every section. The survey includes several sections, with topics regarding general information, incorporating questions regarding the individual's demographic characteristics. The other sections were related to extracting socioeconomic information and the survey includes a section called the Disaster Risk Management, which contains the questions that were used in the analysis presented in this investigation (see the next appendix).

### A2. Survey questions

#### SECTION GENERAL INFORMATION

3.01 What is your relationship with the household head?

1	THE HEAD OF THE HOUSE
2	HUSBAND / MRS
3	CHILDREN (natural or adopted)
4	PARENTS
5	BROTHER/SIST
6	GRAND PARENTS
7	CHILDREN
8	ANOTHER NEAR
9	NOTHING TO ME

3.02 What is your marital status?

1	MARRIED
2	PLACE
3	SINGLE
4	DIVORCE
5	SEPARATION AFTER MARRIAGE
6	SEPARATION AFTER PLACEMENT
7	WIDOW
99	MISSING DATA

3.03 Could you please give me your age?

CATI: MIN 18 MAX 98

3.04 What is your date of birth? (day/month/year)

*IF DOESN'T KNOW, WRITE "99" IN DAY AND MONTH AND "9999" IN YEAR*

3.05 IF THE HEAD OF HOUSEHOLD DOESN'T KNOW THE EXACT DATE, ASK HIS AGE \_\_\_\_\_

3.06 RECORD THE SEX OF THE INFORMANT, IF IN DOUBT ASK

1 MALE

2 FEMALE

3.07 In which department do you live now?

3.08 In which Circuit do you live now?

3.09 In which commune do you live now?

3.10 Do you live in the city or outside?

1 city

2 outside

3.11 What is the highest level of education you successfully completed?

1 NOTHING (NEVER GO TO SCHOOL)

2 KINDERGARTEN

3 PREPARATION 1/1 AF

4 PREPARATION 2/2 AF

5 ELEMENTARY 1/3 AF

6 ELEMENTARY 2/4 AF

7 AVERAGE 1/5 AF

8 AVERAGE 2/6 AF/ CERT

9 SIXTH / 7 AF

10 FIFTH / 8 AF

11 FOURTH / 9 AF / PATENT

12 THIRD/ 7 AF

13 SECONDS

14	BACK
15	FILO
16	HIGHER STUDIES
99	DO NOT KNOW
3.12	Does the household head know how to read and write?
	1. YES
	2. NO
	99 DON'T KNOW
3.13	What is the highest level of education that the household head has successfully completed?
	1 NOTHING (NEVER GO TO SCHOOL)
	2 KINDERGARTEN
	3 PREPARATION 1/1 AF
	4 PREPARATION 2/2 AF
	5 ELEMENTARY 1/3 AF
	6 ELEMENTARY 2/4 AF
	7 AVERAGE 1/5 AF
	8 AVERAGE 2/6 AF/ CERT
	9 SIXTH / 7 AF
	10 FIFTH / 8 AF
	11 FOURTH / 9 AF / PATENT
	12 THIRD/ 7 AF
	13 SECONDS
	14 BACK
	15 FILO
	16 HIGHER STUDIES
	99 DO NOT KNOW
3.14	Is the household head of the house a woman or a man?
	1 MALE
	2 FEMALE
3.15	Last week, from Monday LL to Sunday DD, did the household head work or engage in a commercial, agricultural or other income-generating activity, even if only for one hour?
	1. YES

**SECTION DISASTER RISK MANAGEMENT**

15.01	Did the earthquake of August 14, 2021 affect your home?
1	YES
2	NO >> 15.04
15.02	What is the damage (damage) of the earthquake? INTERVIEWER: SELECT ALL DAMAGES MENTIONED BY YOUR RESPONDEN

	2. NO
	99 DON'T KNOW
3.16	The owner is working...
	1 IN HIS OWN COMPANY, INDEPENDENTLY OR BY HIMSELF
	2 IN A FAMILY OR FAMILY-MANAGED BUSINESS
	3 IN HIS GARDEN, IN GARDEN OR FISHING
	4 AS AN EMPLOYEE OR WORKER IN A PUBLIC COMPANY, A PRIVATE COMPANY OR FOR A LOT OF PEOPLE
	5 LIKE APPRENTICES OR INTERNSHIPS
3.17	What is the company or business the owner works for?
	1 AGRICULTURE/ BREEDING/ FISHING
	2 MINING/GAS/OIL
	3 MANUFACTURING/MANUFACTURING
	4 PROFESSIONAL ACTIVITY/, SCIENTIFIC ACTIVITY,/TECHNICAL ACTIVITY
	5 "ELECTRICITY/ WATER/ GAS.
	6 CONSTRUCTION 7
	TRANSPORTATION
	8 BUY AND SELL GOODS
	9 FINANCIAL SERVICES
	10 "PERSONAL SERVICES AND RELATED ACTIVITIES.
	11 EDUCATION
	12 HEAVEN
	13 PUBLIC ADMINISTRATION, INTERNATIONAL ORGANIZATIONS.
	14RESTAURANTS/BARS/HOTELS/TOURISM
	15 PROPERTY AND VEHICLE REPAIR
	16 INFORMATION AND COMMUNICATION (PUBLISHING, PRODUCTION, TELECOMMUNICATION) TELECOMMUNICATION)
	17 REAL ESTATE ACTIVITY
	18 ADMINISTRATIVE SERVICES AND NON-SPECIALIZED SUPPORT (RENTAL, LABOR, SECURITY)
	19 CRAFTS, ENTERTAINMENT
	20 HOUSEHOLD SERVICE. (such as: maid)

a	SOMEONE IN THE FAMILY DIED OR WAS SERIOUSLY INJURED
b	A FAMILY MEMBER WAS INJURED BUT NOT SERIOUSLY
c	PEDY WORK
d	PEDI HOUSE
e	YOUR HOUSE IS A LITTLE DAMAGED / IT IS CRACKED
f	DEAD ANIMALS

	g	NO DAMAGE (NO LOSS)
	h	OTHER
15.03	Do you own the house where you are (owner)?	
	1	Yes
	2	I rent
	3	I live here but I don't own or rent
	4	I do not know
15.04	What natural disaster threatens the house where you live	
	a Heavy rain	
	1	YES
	2	NO
	98	DO NOT KNOW
	b Heavy thunder	
	1	YES
	2	NO
	98	DO NOT KNOW
	c Flooding	
	1	YES
	2	NO
	98	DO NOT KNOW
	d Hurricane/severe storm	
	1	YES
	2	NO
	98	DO NOT KNOW
	e Heat wave (feeling very hot)	
	1	YES
	2	NO
	98	DO NOT KNOW
	f Drought	
	1	YES
	2	NO
	98	DO NOT KNOW
	g Fire in the fields	
	1	YES
	2	NO
	98	DO NOT KNOW
	h Earthquake	
	1	YES
	2	NO
	98	DO NOT KNOW
	i Landslides	
	1	YES
	2	NO
	98	DO NOT KNOW
	j Rough seas (big sea waves)	
	1	YES
	2	NO

	98	DO NOT KNOW
	k Tsunami	
	1	YES
	2	NO
	98	DO NOT KNOW
	L other (say what)	
15.05	Do you believe that your house, the people who live in your house are prepared, mostly prepared or not prepared at all to be able to face a disaster or an emergency at this moment?	
	1	VERY PREPARED
	2	BE A BIT PREPARED
	3	NOT PREPARED
	98	DO NOT KNOW
15.06	We would like to better understand how people in your household prepare in the event of a disaster or emergency. Do you have any supplies or other items in your home that could be used to help your household in a disaster or emergency?	
	1	YES
	2	NO >>15.08
	98	DO NOT KNOW >> 15.08
15.07	What supplies do you have?	
INTERVIEWER: ASK THE INFORMANT FOR ALL THE MORE PROVISIONS HE HAS. YOU CAN TAKE MULTIPLE ANSWERS		
	a	BOXED FOOD
	b	BOTTLED WATER
	c	BATTERY OPERATED RADIO
	d	FIRST AID KIT
	e	FLASH
	f	MONEY / MONEY
	g	DRUGS / PRESCRIPTION DRUGS
	h	IMPORTANT DOCUMENTS
	i	PEARLS OR/AND MORE
	j	PADSI (CLOTHES YOU CAN WEAR IN THE RAIN)
	k	YOUR BLANKET/ BLANKET (BLANKET OR SLEEPING BAG)
	l	MASK
	l	SOAP AND/OR HAND SANITIZER
	o	OTHER (say what)_____
15.08	Have you and your family members ever talked about or planned what you would do in a disaster or emergency?	
	1	YES
	2	NO>> 15.10
	98	DO NOT KNOW >>15.10
15.09	What did you discuss?	
	a	PLACE FOR ALL MEMBERS OF THE FAMILY TO MEET
	b.	LIST OF IMPORTANT PHONE NUMBERS OR CONTACTS
	c.	MEASURES TO SECURE THE HOUSE OR MAKE IT BETTER

d	WHO TO ASK FOR ADVICE FOR A POSSIBLE EVACUATION, FOR EXAMPLE MEMBERS OF THE CIVIL PROTECTION COMMITTEE.	
e.	LIST OF IMPORTANT DOCUMENTS, ETC	
f	MEASURES FOR FAMILY MEMBERS WITH SPECIAL NEEDS	
g.	WARNING SIGNS WHEN THERE IS SOMETHING IN THE COMMUNITY	
h.	PLAN TO EVACUATE OR RUN FROM THE AREA	
i	GO TO A SHELTER OR A CENTER WHERE PEOPLE ARE RECEIVED	
j	OTHER (say what)	
15.10	Compared to before the pandemic, do you have the impression that your household is better prepared, not too well prepared or less prepared to face a disaster or an emergency?	
1	BE MORE PREPARED>>	15.12
2	THE SAME YEAR >>15.12	
3	LESS PREPARED	
98	DO NOT KNOW >>15.12	
15.11	Why do you think your household is less prepared to deal with a disaster or an emergency?	
a	LOCATION OF WORK OR SOURCE OF INCOME	
b.	REDUCED INCOME (SAME WORK/SAME MONEY-MAKING ACTIVITIES)	
c.	THE FAMILY MEMBER DIED OR LIVED ELSEWHERE	
d	A FAMILY MEMBER BECAME ILL, DISABLED OR UNABLE TO WORK FOR HEALTH REASONS	
e.	THE FAMILY HAS BECOME LESS MONEY BECAUSE EVERYTHING IS SOLD BY GUYS (THEY BECOME MORE EXPENSIVE THAN BEFORE)	
f	FAMILIES HAVE NO ECONOMY	g. THE ANIMALS ARE PURCHASED OR SOLD WITH THE FAMILY
h.	THE FAMILY CANNOT GET MONEY TO LOAN (BANK OR MICRO CREDIT)	
i	NO WAY TO RECEIVE HELP FROM OUTSIDE TO ANSWER WITH FOOD AND OTHER THINGS WE NEED	
j.	THERE IS NO WAY (LACK OF WAYS) FOR US TO GET ASSISTANCE TO BE ABLE TO MOVE TO A SAFE PLACE IN THE EVENT OF A DISASTER	
k.	FAMILY (OTHER KISSES) DON'T GIVE MONEY	
l.	OTHER (say what)	
15.12	Does your community have a warning system that monitors weather (such as storms, hurricanes) and informs community members about upcoming threats?	
1	YES	
2	NO	
98	DO NOT KNOW	
15.13	Does your community have...	
a	Disaster response or emergency plan?	
1	YES	
2	NO	
98	DO NOT KNOW	

b.	A committee or organized group that decides what to do in the event of a disaster or emergency?	
1	YES, AN NGO OR LOCAL ORGANIZATION	
2	YES THE CIVIL PROTECTION COMMITTEE	
3	NO	
98	DO NOT KNOW	
c.	Are community members trained to help others in disaster situations?	
1	YES	
2	NO	
98	DO NOT KNOW	
d	Route in case of evacuation	
1	YES	
2	NO	
98	DO NOT KNOW	
e.	An identified shelter where people can go in case of a disaster?	
1	YES	
2	NO	
98	DO NOT KNO	



### A3. Summary Statistics for each survey wave

**Table 4. Relative Frequencies some interviewed characteristics**

	2021	2022	2023
	%	%	%
<b>Sex</b>			
Male	58.4	57.6	56.5
Female	41.6	42.4	43.5
<b>Age</b>			
18 to 29	17.6	19.9	19.3
30 to 49	51.9	64	65.2
50+	30.5	16.1	15.5
<b>Education</b>			
No			
Educ./Primary	26.2	23.7	24.2
Secondary	55.8	55.5	59.5
Tertiary or more	18	20.7	16.3
<b>Quintiles</b>			
1er	22.5	22.3	21.5
2nd	22	21.6	22
3rd	18.4	19.6	19.1
4th	18.1	18.3	19.9
5th	19	18.2	17.4
<b>Area</b>			
Urban	60.2	66.3	66.8
Rural	39.8	33.7	33.2
<b>Region</b>			
Ouest	36.4	36.9	36.9
Southern region	20.6	20.3	20.3
Northern	19.7	20.1	20.1
Central	23.4	22.7	22.7

#### A4. Types of natural hazards threatening households by area (Urban-Rural)

**Table 5: Self-reporting of the types of natural hazards threatening households by Area (2021-2023)**

Type of hazard	2021						2022						2023					
	Urban			Rural			Urban			Rural			Urban			Rural		
	Bottom 40 percent (mean)	Top 60 percent (mean)	Difference	Bottom 40 percent (mean)	Top 60 percent (mean)	Difference	Bottom 40 percent (mean)	Top 60 percent (mean)	Difference	Bottom 40 percent (mean)	Top 60 percent (mean)	Difference	Bottom 40 percent (mean)	Top 60 percent (mean)	Difference	Bottom 40 percent (mean)	Top 60 percent (mean)	Difference
Heat waves	0.6062	0.5897	-0.0166	0.5397	0.5694	0.0297	0.6217	0.5462	-0.0754**	0.5675	0.6007	0.0332**	0.7135	0.6181	-0.095***	0.6391	0.6481	0.0090***
Tropical cyclones/Hurricanes	0.5727	0.5394	-0.0332	0.6737	0.6571	-0.0166	0.6312	0.4426	-0.188***	0.6694	0.5423	-0.127***	0.5961	0.4744	-0.121***	0.7469	0.5100	-0.237***
Extreme rainfall	0.5755	0.5073	-0.0683*	0.6038	0.6095	0.0057*	0.5515	0.3843	-0.167***	0.6029	0.4713	-0.131***	0.5562	0.3689	-0.187***	0.6772	0.4927	-0.184***
Drought	0.5380	0.4500	-0.0880**	0.5530	0.6431	0.0900**	0.5509	0.3856	-0.165***	0.5857	0.4938	-0.091***	0.7307	0.5824	-0.148***	0.7671	0.6275	-0.139***
Severe storms	0.4057	0.3209	-0.0848**	0.4765	0.4796	0.0031**	0.3920	0.2521	-0.139***	0.4100	0.3336	-0.076***	0.4079	0.2850	-0.122***	0.4859	0.3770	-0.108***
Floods	0.3970	0.3635	-0.0335	0.4377	0.3523	-0.0854	0.4028	0.2722	-0.130***	0.3762	0.3464	-0.029***	0.4183	0.3360	-0.082***	0.4133	0.3013	-0.1120**
Earthquake	0.2362	0.1362	-0.100***	0.2712	0.2263	-0.045***	0.6830	0.6482	-0.0348	0.7412	0.6342	-0.1069	0.7385	0.6447	-0.093***	0.7712	0.6616	-0.109***
Wildfires	0.1811	0.1050	-0.0761**	0.3100	0.2780	-0.0319**	0.1512	0.0912	-0.0601	0.2272	0.1493	-0.0780**	0.2261	0.1566	-0.069***	0.3958	0.2162	-0.1795**
Tsunami	0.2278	0.1657	-0.0621*	0.1507	0.1298	-0.0209*	0.3234	0.2335	-0.089***	0.2547	0.2499	-0.004***	0.3850	0.3513	-0.0337	0.2906	0.2546	-0.0359
Landslides	0.1904	0.1243	-0.0661**	0.2515	0.1936	-0.0580**	0.2339	0.1994	-0.0345	0.3092	0.2124	-0.0968	0.3202	0.2332	-0.087***	0.3585	0.2423	-0.1162**
Storm surges	0.1487	0.0846	-0.0640**	0.1310	0.1190	-0.0120**	0.1365	0.0643	-0.072***	0.0633	0.0777	0.0143***	0.1638	0.1331	-0.0308	0.1298	0.0988	-0.0310
Other	0.0236	0.0354	0.0118	0.0472	0.0280	-0.0192	1.9490	2.5842	0.6352	1.9110	1.8389	-0.0721	0.0779	0.0211	-0.0569*	0.1032	0.0620	-0.0412*

**Table 6: Self-reporting of the types of natural hazards that threaten the household by educational level of the head of household – 2023**

Type of hazard	No educ./Primary (mean)	Secondary or more (mean)	Difference
Heat waves	.6377	.6589	-.0211
Tropical cyclones/Hurricanes	.6091	.5493	.0598*
Extreme rainfall	.5723	.4780	.0943***
Drought	.7013	.6474	.0539
Severe storms	.3897	.3684	.0213
Floods	.4213	.3563	.0650*
Earthquake	.6875	.6867	.0008
Wildfires	.2723	.2088	.0634**
Tsunami	.2962	.3456	-.0494
Landslides	.3331	.2662	.0669**
Storm surges	.1196	.1369	-.0174
Other	.0453	.0664	-.0210

Note: 1) Tests of significance with robust standard errors comparing means between groups are reported \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. 2) Results are from the entire sample of wave 4.