

The Rough Road to Services and Livelihood Opportunities in Rural Haiti and the Added Impact of Natural Disasters

Aiga Stokenberga

Cecilia Escalante

Karla Dominguez Gonzalez

Xavier Espinet

Malaika Becoulet



WORLD BANK GROUP

Transport Global Practice

August 2023

Abstract

Mobility of goods and people in rural Haiti is constrained by the sparse road network and low maintenance of existing infrastructure. These challenges are further exacerbated by frequent natural disasters, including seasonal floods and earthquakes of significant magnitudes. This study conducted household surveys, qualitative interviews with humanitarian and development organizations on the ground, and spatial and statistical analysis to understand the impact of the relative importance of various constraints to accessing schooling, health care, and livelihood opportunities in rural Haiti, especially focusing on the most marginalized population groups. The various data collected corroborate the conclusion that transport issues—travel time, flooded roads, and lack of continuously functioning public transport services, among others—are central in the local residents' ability to access services and livelihood

opportunities. At the same time, for many marginalized people, such as women and people living with a disability, other significant barriers are present, in terms of lack of affordability, inappropriate design of school and health care facilities, risk of assault, discrimination, and cultural norms. Living in a community where roads were damaged by the August 2021 earthquake is associated with reduced odds of having accessed needed health care or sold any of the produced agricultural harvest in the following months and with higher odds of children having missed school. Overall, the findings point to the need for a broad set of interventions—combining infrastructure and complementary policies—to allow everyone, including the most marginalized groups, to gain full access to health, education, and livelihood opportunities.

This paper is a product of the Transport Global Practice. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at <http://www.worldbank.org/prwp>. The authors may be contacted at astokenberga@worldbank.org.

The Policy Research Working Paper Series disseminates the findings of work in progress to encourage the exchange of ideas about development issues. An objective of the series is to get the findings out quickly, even if the presentations are less than fully polished. The papers carry the names of the authors and should be cited accordingly. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

The Rough Road to Services and Livelihood Opportunities in Rural Haiti and the Added Impact of Natural Disasters

Aiga Stokenberga,¹ Cecilia Escalante, Karla Dominguez Gonzalez, Xavier Espinet, and Malaika Becoulet

JEL: O18, Q54, I14, I24

Keywords: rural transport, flood, earthquake, natural disaster, marginalization

¹Corresponding author: astokenberga@worldbank.org. The authors would like to acknowledge the support provided by the Unite Central Execution at the Ministry of Public Work, Transport and Communication, and inputs by Sebastien Gachot, Jery Rambao, Luckny Zephyr, Jose Moran, Rebecca Balis, Milenita Vega, Nathalie Picarelli, Claudia Ann Sylvia Tassy, and the survey teams from the Diagnostic & Development Group S.A. (DDG) and DEMDEV. This research was possible thanks to the funding support from HRIETF and QII.

1. Introduction

Haiti is the poorest country in the Western Hemisphere with high inequality, and the COVID-19 pandemic likely increased poverty (World Bank Group, 2022a). Extreme poverty has remained stagnant in rural areas, where 38 percent of the population is extremely poor. The Gini coefficient is the highest in the Americas, and Haiti's challenges include violence and insecurity in a context rife with natural disasters, posing significant barriers to the achievement of the right to education, health care, and decent life for all. Armed conflict has caused the displacement of approximately 20,000 individuals and has significantly impacted the economic situation in the country. About 1.5 million people are estimated to have been affected by loss of access to basic services, and gender-based violence is also informed by armed violence and instability. Haiti has the highest maternal mortality rate in the Western Hemisphere, in part due to the limitations on health care access challenges impacting antenatal care visits for pregnant women. An estimated 56 percent of the population is under the age of 25, and the youth face worsening economic opportunities (World Bank Group, 2022b). Lack of quality education, coupled with limited opportunities, especially in rural areas, and vulnerability to recruitment by gangs create a challenging situation for the large and young population.

Transport services in Haiti are mainly provided via roads. However, the road network is limited to about 3,450 km for a territory of 28,773 km². In comparison, Burundi (27,834 km²) has 12,322 km of roads. In addition to a small road network, mobility of goods and people is further constrained by the poor condition of the network and low maintenance of existing infrastructure.

In general, economic outcomes have failed to improve given Haiti's complex security and natural disaster crises, both of which contribute to its fragility. Over 3 million children were unable to attend school for months at a time during 2020-2021 for security reasons, as well as Covid-19 related restrictions (Human Rights Watch, 2022). Insecurity has impacted educational opportunities, with several schools having closed due to insecurity since 2018 (World Bank Group, 2022b). The security considerations are so profound that the UN Human Rights Committee suggested developing strategies with security forces to ensure that schools are permanently made safe, including by increasing the police presence, particularly when the students are outside or traveling to school, and providing all school students with transport services with secure buses (Human Rights Council, 2021). There are particular concerns about low enrollment of girls in secondary schools, especially in rural areas, due to inadequate sanitation facilities in schools, girls experiencing extreme poverty and child labor, high rates of sexual harassment and abuse on the way to and from school, and the lack of sexual and reproductive education (CEDAW Committee, 2016).

Haiti experiences many natural disasters that impact access to basic services and further destabilize the country. Haiti is ranked third of all countries globally to be affected by climate hazards by the Climate Risk Index in 2021: an estimated 96 percent of the population is exposed to at least two hazards, including hurricanes, flooding, earthquakes, mudslides, and drought, impacting access to services and economic opportunities. For instance, the massive earthquake in August 2021 limited access to two national roads, cutting off parts of the country from services. Access is further limited by gang control on national roads and blocking access to gas and petrol. Mountainous regions in the north are often impassable, limiting access to services for populations who live there, while southern regions are not accessible due to violence interfering with safe passage. In 2021, transport unions protested and went on strike due to the insecurity affecting their work (UNOCHA, 2022). Additionally, poor connectivity and road infrastructure has contributed to the deterioration of the food crisis in Haiti with 4.7 million people, or nearly half of the population, experiencing high levels of acute food insecurity, including 19,200 classified as Disaster (IPC Phase 5 - Famine) (UNOCHA, 2023). Most areas identified as having a Food Security Emergency are in the Grand South, epicenter of the earthquake of August 2021, in the North, North-East and Artibonite, North-West, Gonâve, as well as three municipalities in the metropolitan area that are most affected by armed

gang activities. Poor infrastructure has been a long-standing issue undermining agricultural productivity in Haiti, with an estimated of 30 to 40 percent of perishable goods lost due to lack of access to markets (USAID, 2018).

Climate change is expected to increase the frequency, intensity, and impacts of extreme weather events and Haiti lacks adequate preparedness and resilience-building mechanisms (World Bank Group, 2022a). Rising temperatures due to climate change increase risks of pandemics and infectious disease, as well as health outcomes related to extreme heat exposure (Human Rights Council, 2021). Climate change is also expected to affect the population's main sources of income by limiting crop yields and further flooding agricultural land and disproportionately affecting the rural poor. Livelihood activities are also vulnerable to climate change due to anticipated unpredictable rain patterns and increasing droughts during months critical for food production (World Bank Group, 2022a). The impacts of climate change and other climate-related disasters affect rural women disproportionately, given that they rely heavily on access to natural resources for their daily survival (CEDAW Committee, 2016).

This mixed methods study aimed to understand the impact of various physical mobility related barriers to accessing schooling, health care, and livelihood opportunities in rural Haiti, especially focusing on the most marginalized population groups such as women, girls, people living with a disability, and people experiencing multiple overlapping types of marginalization. The study's geographic focus is on two departments in the southwest of the country, Sud and Nippes. The study also tried to place these mobility related barriers in the overall spectrum of challenges that hinder such access, including insecurity, and cultural norms. Finally, the study investigates the additional impact of regular climate hazards such as floods as well as a major natural disaster (7.2 magnitude earthquake that shook the Hispaniola island in August 2021, followed by a 5.5 magnitude earthquake in January 2022) on the local residents' mobility behaviors. In doing so, it contributes to a deeper understanding of the key determinants of mobility in rural Haiti, and how that mobility may impact socioeconomic outcomes.

2. Review of the literature

The limited health facilities and health services available, coupled with poor hygiene and sanitation and lack of clean drinking water present a challenge to meeting Haiti's health care access needs (World Bank Group, 2022a). However, the primary reason cited for most populations not accessing health care is the cost of medical treatment. There is limited budget for health, in particular, women's health care, and rural areas are most affected (CEDAW Committee, 2016). In a study on HIV treatment participants, the economic impact of accessing treatment likely caused diminished patient retention. The effect was demonstrable for transportation costs greater than US\$2 (Sowah et al., 2014). However, there are also impacting factors such as stigma of HIV/AIDS. UNAIDS reported that 54 percent believed students with HIV should not attend school (U.S. Department of State, 2022).

In many studies conducted on health outcomes in Haiti, a major challenge to improved health outcomes is the distance to health facilities and accessing them. For some of the population, the only way to access health facilities is by foot. In one study, for women accessing health facilities, distance was the primary reason for women aged 15-49 not seeking health care for 62 percent of rural households (Perge and Touray, 2017). Similarly, evidence suggests that poor road conditions in Haiti significantly reduce the likelihood of receiving timely antenatal care (ANC), and of receiving the recommended number of ANC visits (Gage and Calixte, 2006): 43 percent of women living in neighborhoods linked to the nearest urban area by an asphalt road completed the recommended number of ANC visits before birth, compared to only 14 percent in areas linked by unpaved roads. The time and monetary costs of travel compounded by unhelpful topography, poor road conditions and lack of public transport, explain why distance has been

found to be a crucial dimension of the use of these services. The physical access to health facilities is further limited by security and impacts of natural disasters that inhibit access and transport. Where transport is available and affordable, it may only be available by motorcycle, which is ineffective for various health concerns (Raymondville et al., 2020).

These challenges disproportionately affect the marginalized populations. For example, as many as 73 percent of extremely poor rural households in Haiti have *at least one woman* who reports not being able to satisfy medical needs due to distance to the health facility (Perge and Touray, 2017). Populations with disabilities face additional health challenges due to more limited access to health and education services and challenges obtaining employment. Opportunities to access services often depended on the economic status of the family (U.S. Department of State, 2022). Health services in Haiti do not consistently provide access to sexual and reproductive health care, and discrimination of LGBTIQ+ populations remains prevalent (OHCHR, 2022).

Women across all age groups are less likely to be employed, and young women (age 15 to 24) are more likely than men to not be in education, employment, or training. There is also some evidence that in the wake of the COVID-19 pandemic, women have been more affected by job loss compared to men and are also more likely to report increased household responsibilities (World Bank Group, 2022b). Women's access to employment is hindered by the lower rate of education and gender stereotypes that cause them to dedicate time to domestic work. Women also have less access to credit and are more likely to be in the informal sectors. This is despite the fact that in rural areas households are, to a large extent, headed by women and that "a single woman and her children make up the family unit in most cases" (Immigration and Refugee Board of Canada, 2017).

While there are legal protections prohibiting sex-based discrimination under law, there are additional factors that contribute to gender inequality. In part, this is due to the large informal sector in Haiti, which employs 87 percent of the population. In terms of the transport sector, women are not represented due to gender stereotypes and time poverty (Gandini et al., 2021).

Unsafe transport is another factor that disproportionately affects women, who may be more vulnerable to violence and armed robberies while traveling with their goods or to and from work. Transport infrastructure poses safety risks for those traveling for work and with merchandise. Other safety and security concerns include the high rates of sexual harassment and abuse that affect women's travel to and from jobs, and that women are vulnerable to coercive and exploitive practices in the workplace, such as sexual harassment (U.S. Department of State, 2022).

The high rate of natural disasters in Haiti and the population affected means that there is limited access to services for the Haitian population when natural disasters occur. As a result of the 2021 earthquake, water and sanitation infrastructure suffered extensive damage, adding to the existing challenges of limited and poorly equipped health facilities. Of 159 health facilities, 88 were reportedly affected (Human Rights Watch, 2021). Poor transport infrastructure disrupts rescue efforts, access to essential services, and conducting recovery efforts after the occurrence of a natural disaster, and many cities and regions around the country lack transportation diversity, meaning that bridge damage, road damage, landslides, and floods severely affect transportation from one location to another, impairing relief and recovery efforts; insecurity and inaccessibility are also major obstacles in the disaster response process (Ndambukia and Al Hitmib, 2021).

3. Methodology

Spatial analysis was conducted covering the two regions to identify the objectively measured accessibility gaps and their heterogeneity across space and identify the most critical roads for accessing health and

education facilities and markets in the Nippes and Sud. Specifically, we measure the number of people who have access to hospitals, schools and local markets, by computing for each human settlement the time it takes to reach the nearest service. In addition, we identify the roads that are the most likely to be used by the population when trying to reach basic services. If one of these “critical” roads, for example, is made unavailable because of a natural disaster such as a flood or an earthquake, a large number of people would be impacted, with longer travel times as a consequence of having to take an alternative route. Details on the data and its initial preparation process are described in Annex 1.

Having the road network, it is possible to compute travel times between two nodes in it using shortest path algorithms and computing the length (in time) of the path. The next step is to integrate origin and target destinations. The first is typically a human settlement, while the latter is a point of interest such as a hospital, a school or a local market.

Next, we find the closest points on the road network to the origin and target destinations: this induces an additional travel time, because we assume a person has to walk from the settlement to the road at a speed of 4 km/h. If the settlement or the target are further than 40 km from the road network, we assume that there is no path linking the origin with the destination on the road network. Next, the portion of travel time on the road network is computed using a shortest path algorithm. To compute the time to the nearest facility, such as a hospital, from a village, it is necessary to first determine the closest hospital. To do this, we use a search procedure, by searching first for hospitals within a 20 km radius and increasing the search radius by 20 km until one or more are found. After this, travel time is computed and only the hospital with the smallest time is retained. It is then possible to compute the travel time for a given settlement. To aggregate to larger levels, we compute population-weighted average travel times.

Finally, using the shapefile with roads that were estimated to be damaged by the August 2021 earthquake, we build a *damaged* road network, where these roads (along with roads in a buffer zone of 100m around them) have been removed (Figure 1). This results in a larger travel time for certain communes, which we are able to estimate.

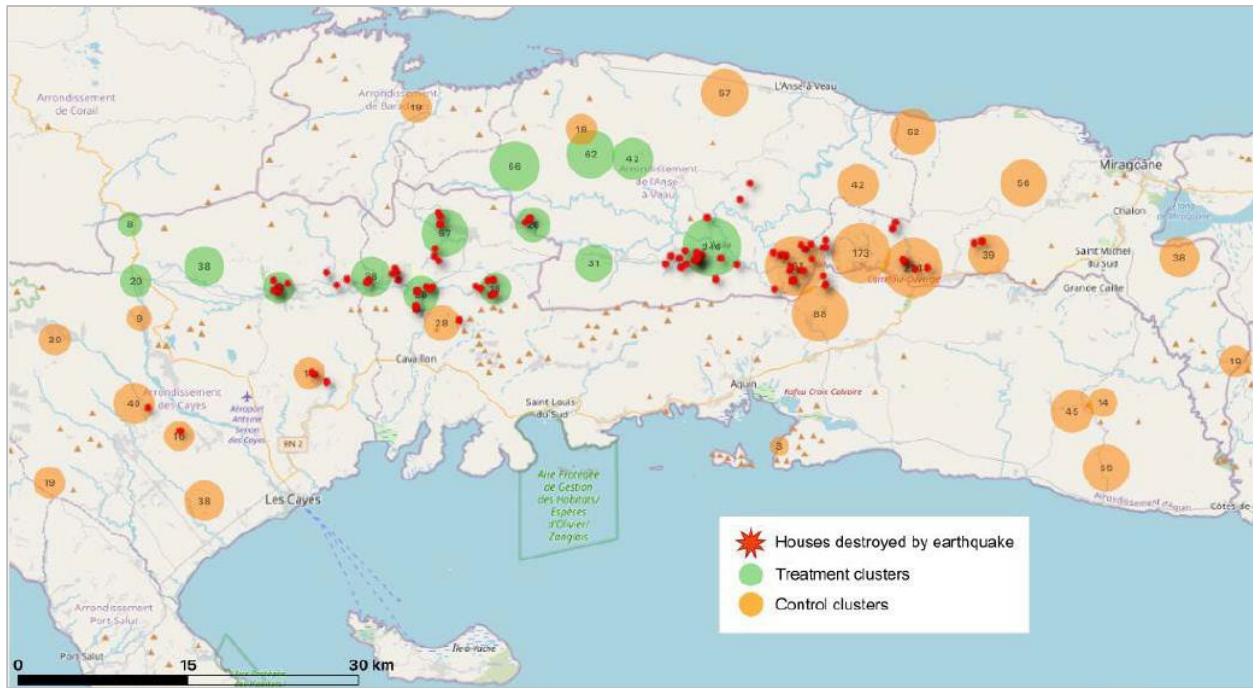
Figure 1: Road network of Sud and Nippes, including roads assessed as damaged by the August 2021 earthquake



Source: Study team based on peak ground acceleration data provided by U.S. Geological Survey (USGS)

To measure road criticality, we compute each road’s betweenness centrality, defined as the fraction of shortest paths linking settlements to hospitals that pass through the road, where the shortest-paths are computed taking into account travel time, and not just distance. Thus, centrality can be measured as a percentage: a centrality of 10 percent means that that fraction of paths going from settlements to hospitals pass through the road in question. The same procedure is followed to compute the criticality of roads for accessing schools.

Figure 2: Households surveyed in the 2022 survey



To gain insights on the various mobility issues and other constraints faced by individuals in Sud and Nippes and their relationship to behaviors regarding access to education and health facilities and markets, the study implemented two rounds of household surveys, in April 2021 and in July-August 2022. The initial purpose of the research – and the two rounds of surveys – was to evaluate the impact of the rural roads improvements that were to be financed with World Bank support but ended up being postponed due to the August 2021 earthquake. Instead, the surveys served the purpose of (i) gathering detailed data on mobility constraints and (ii) understanding the association between earthquake exposure and mobility constraints and health/schooling/market access behaviors. The first round surveyed 2,464 households, and the second round – 2,034 households. The surveys were administered in most of the same statistical enumeration areas (or SDEs, for its French acronym). Since the purpose of the follow-up study was modified following the August 2021 earthquake to specifically analyze the impact of the earthquake damage, its sample was disaggregated as follows: (i) Treatment group: households located in SDEs that have a road damaged by the earthquakes crossing at least part of them, or that are located within 2 km from such a road (1,326 households), and (ii) Control group (708 households) (see Figure 2).

Both surveys included questions on the households' socioeconomic characteristics and perceived mobility and infrastructure constraints. The first survey also asked about broader constraints to accessing schooling, health care, and livelihood opportunities that have to do with personal constraints and cultural norms, including lack of childcare, inability or lack of permission to travel alone, or a disability that prevents free movement. The second survey, on the other hand, included additional questions on the specific impact of the earthquake related damage as an obstacle to accessing opportunities. The current paper mostly focuses on the results of the second round survey when discussing descriptive findings and statistical associations.

The geographical distribution of samples between the departments of Nippes and South is similar in both surveys (65 percent of the first survey sample was in Nippes compared to 63 percent for the follow-up sample; conversely, 35 percent of the first survey sample was in Sud, compared to 37 percent for the

follow-up sample). On the other hand, several demographic indicators are quite different between the two samples: while women, pregnant women and women who had given birth in the previous 6 months had been oversampled during the first survey, the follow-up sample was selected more randomly. In terms of socio-economic data, the two samples are relatively similar (Table 1). This also includes access to private and public means of transportation, with approximately a fifth of the respondents' households owning a motorcycle, about three-quarters having no private transport vehicles, and one in ten respondents not having access to any public transport. However, even among the respondents whose households own at least one transport vehicle, not all (especially women) have the vehicle available for their use, the share being much higher in the 2021 sample than the 2022 one.

Table 1: Basic statistics and socio-economic characteristics of the survey samples collected in 2021 and 2022

	First survey (2021)	Follow-up (2022)
<i>Living in Nippes (%)</i>	65	63
<i>Living in Sud (%)</i>	35	37
<i>Women (%)</i>	79	58
<i>Women who are pregnant or have given birth in last 6 months (%)</i>	25	8.4
<i>Respondents who are 26-35 years old (%)</i>	30	21
<i>Respondents who are 36-45 years old (%)</i>	25	21
<i>Respondents who have not received any education (%)</i>	20	27
<i>Respondents with some primary education (%)</i>	55	43
<i>Respondents with some secondary education (%)</i>	19	23
<i>Women who declare being independent workers (%)</i>	47	34
<i>Men who declare working in agriculture (%)</i>	45	46
<i>Respondents who report no individual personal income (%)</i>	23	22
<i>Of those women (%)</i>	80	75
<i>Respondents whose household earns US\$70 or less per month² (%)</i>	47	40
<i>Respondents whose households have no private means of transport (%)</i>	77	76
<i>Respondents whose households own a motorcycle (%)</i>	20	22
<i>Respondents who cannot use the household vehicle for their needs – men (%)</i>	9	2
<i>Respondents who cannot use the household vehicle for their needs – women (%)</i>	16	4
<i>Respondents who do not have access to any public transport³ (%)</i>	8	10

Source: Household surveys collected by the team in Sud and Nippes in 2021 and 2022

Based on the responses provided in the two survey rounds, the study analyzed the relative importance of transport related barriers among all the various constraints that inhibit household access to health care, schooling, and livelihood opportunities. Based on the results of the survey implemented in 2022, statistical analysis was also conducted to assess whether there are statistically significant differences in health, education and market access behaviors between the households living located in villages within 2 km of a road damaged by the earthquake versus those living in the unaffected villages.

Complementing the surveys, interviews were conducted with local representatives of a number of development organizations in Haiti, including international and local (UNICEF, Action Aid, Care Haiti, Beyond Borders, and others) to gain additional qualitative insights on the barriers to mobility for specific marginalized groups.

² Using the baseline's exchange rate of November 2021.

³ Includes buses, minibuses, vans, communal taxis, moto-taxis, and any other type of communal means of transportation.

4. Key findings from the complementary analyses

4.1. Accessibility gaps to schools, hospitals, and markets

The spatial accessibility analysis conducted as part of this research project suggests that roughly 30-40 percent of the region's population live within 30 minutes of motorized travel from the nearest hospital and nearest market (Figure 3). Overall, access to hospitals is relatively good throughout the urbanized parts in the south of the region, excluding the Île à Vache (in black in Figure 4), where no hospital is present. Plaisance du Sud, Petit Trou de Nippes and Grand Boucan also show poor quality access, with average times of about 3 hours to access a hospital. The accessibility profile to markets is similar to the one for hospitals; however, the spatial distribution is slightly different: the communes to the west, Grand Boucan and Baradères have overall worse access than the rest of the study region.

Figure 3: Population within a given travel time to hospitals and markets in Sud and Nippes (intact road network) (%)

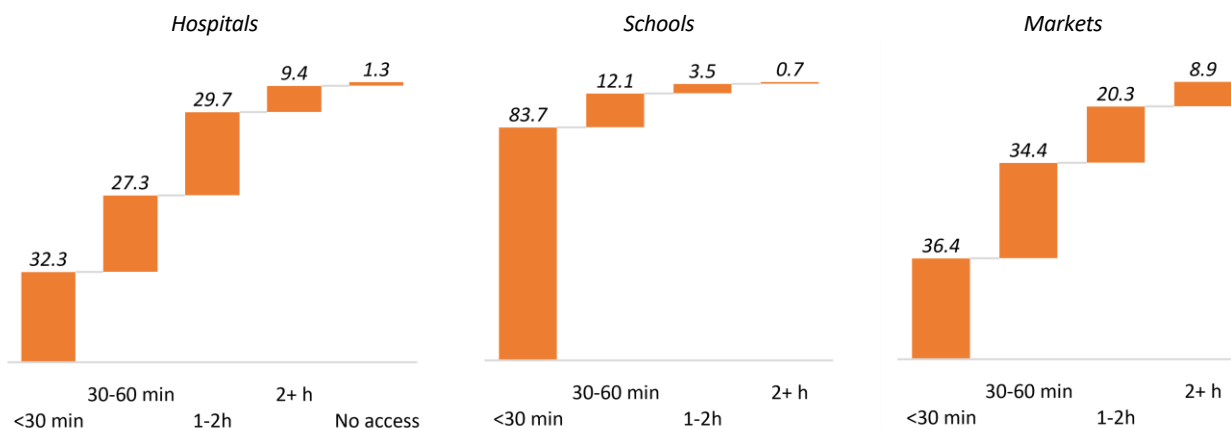
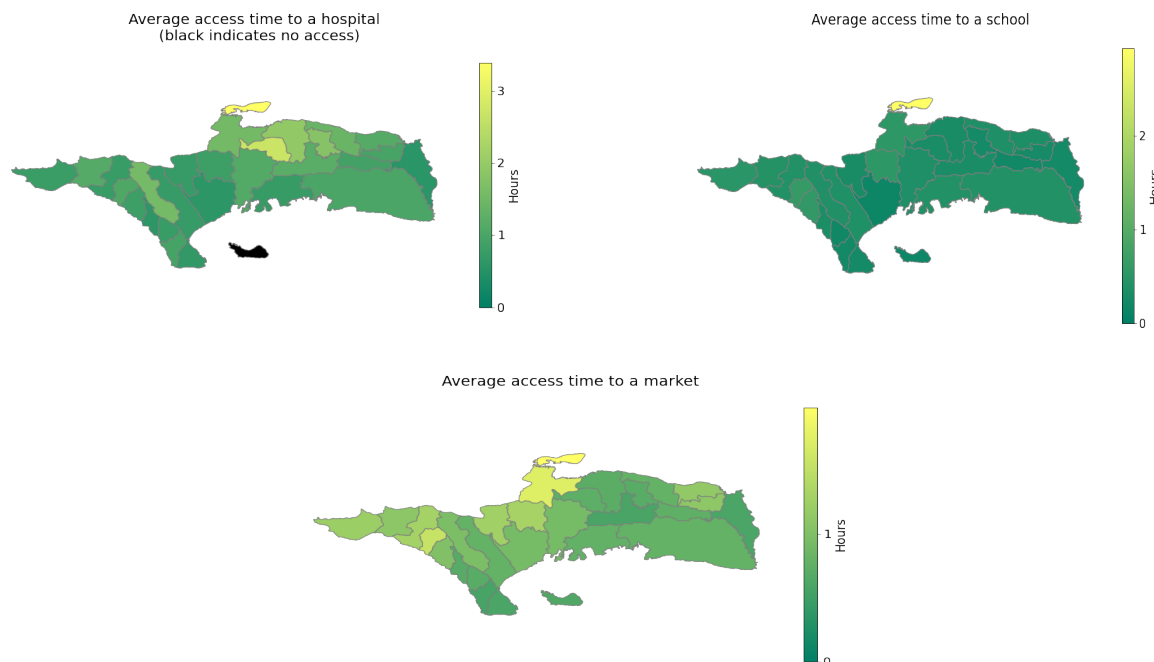


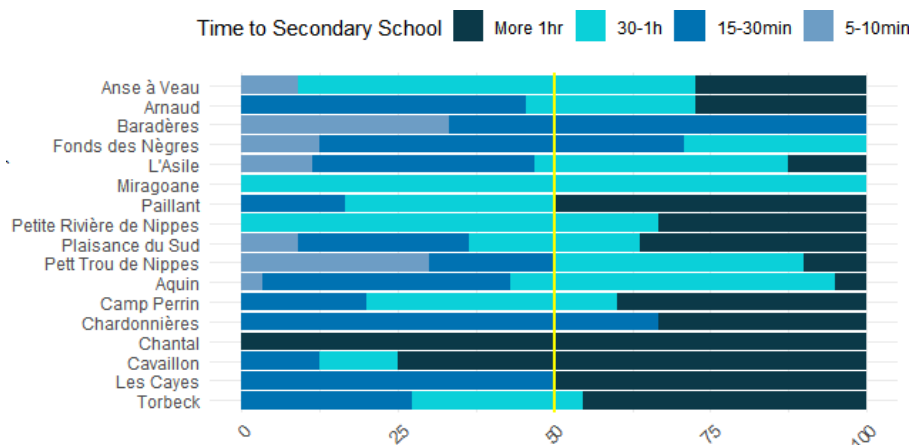
Figure 4: Population-weighted average access time to the nearest hospital (left), school, (right), and market (bottom), not considering physical or functional status of the facilities



Source: Findings by study team

Because the school network is very dense, the theoretical access to the nearest school in the study region is relatively good: nearly half of the population live within 15 minutes of a school by motorized transport. However, as in the case of hospitals, access time in Grand Boucan is particularly bad, due to the poor school and road coverage. Moreover, the spatial data doesn't allow distinguishing by type of school. Most importantly, the dataset does not indicate the functional status of the schools or how they were impacted by the most recent earthquakes (the topic of focus of section 4.4.).

Figure 5: Travel time to secondary school (% of respondents)



Source: Household survey implemented by the study team in April 2021

The household survey data collected in the two regions, in fact, reveals that the real travel times to schools are longer, mostly because the majority of children walk to school rather than use motorized transport. Overall, 37 percent of the children living in Nippes and Sud take between 15-30 minutes, and 31 percent between 30 minutes and 1 hour to arrive at their primary school. About 16 percent travel to school for more than one hour, concentrated in Anse a Veau and Arnaud in Nippes (and they mostly walk), and Cavaillon and Camp Perrin in Sud. For children attending secondary education, 30 percent take between 30 minutes to 1 hour to get to school, 26 percent take 15 to 30 minutes, and another 14 percent over an hour (over half in places like Chantal, Cavaillon and Paillant) (Figure 5).

4.2. Transport related access barriers to health care, schooling, and markets

4.2.1. Health care

In both survey rounds, 88 percent of women respondents – either pregnant or who had given birth in the previous 6 months – had received at least one antenatal consultation with a health care professional in the previous 6 months. In the baseline study, 30 percent of them declared having missed a medical exam during their pregnancy, while in the follow-up study the respective share was even larger – 47 percent. The most common means of transportation for pregnant women to go to a health care facility was the privately-owned motorcycle (77 percent of women respondents who are either pregnant or who had given birth in the previous 6 months used it at least once), followed by walking/foot (38 percent) and some means of public transportation (26 percent).

Based on the responses received in both survey rounds, transport issues are central in the local residents' ability to access health care services. Eighty percent of the 2021 survey respondents identified *'it takes a long time to get to the health facility'* as a constraint to accessing health care, followed by *'flooded roads'* (65 percent), and *'no means of transport available'* (63 percent). The time it takes to get to a facility was

also the most frequently reported constraint in the follow-up study, though by a smaller fraction of respondents (62 percent). Pregnant women, women who had given birth in the last 6 months, and women in need of health care services tended to report this specific issue more frequently than other groups. In the 2022 survey, the second and third most frequently reported constraints to accessing health care were “cannot afford transport” (mentioned by 40 percent of respondents) and “flooded roads” (mentioned by 39 percent of respondents), respectively. It is possible that flooded roads were more salient in the responses in the 2021 survey because it was implemented in April (during the rainy season), while the 2022 survey was implemented in July-August (after the rainy season).

Moreover, in the April 2021 survey, 63 percent of respondents who said there is some public transportation in their community noted that public transport services are not actually available during the rainy season, the share being much higher in Nippes (73 percent) than in Sud (48 percent). As expected, respondents that have more than one public transport mode available are more likely to say that they have availability all year round: 91 percent of the people that reported having three modes of public transport versus just 27 percent of people that only have one mode of public transportation available (Figure 6). Having only one type of public transport available is the reality in several communes in the region, as shown in Figure 7, with mototaxi reported as the only public transport alternative in Les Cayes, Chantal, Camp Perrin, Plaisance du Sud, Paillant, and Miragoane.

Figure 6: Availability of public transport all year round, by number of modes of public transport available (% of respondents)

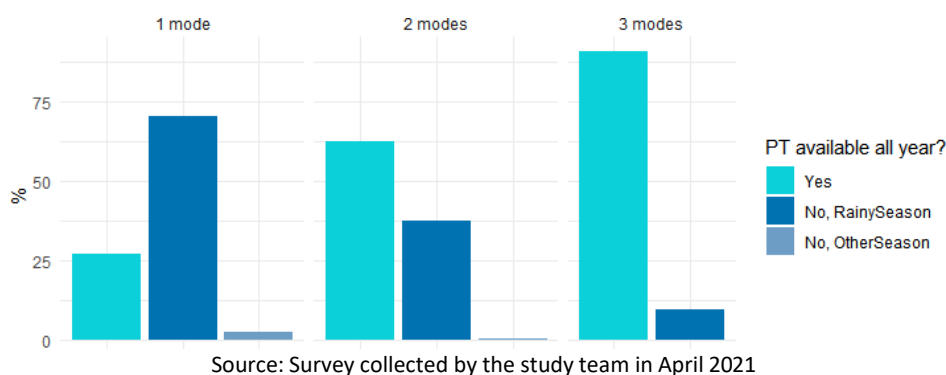
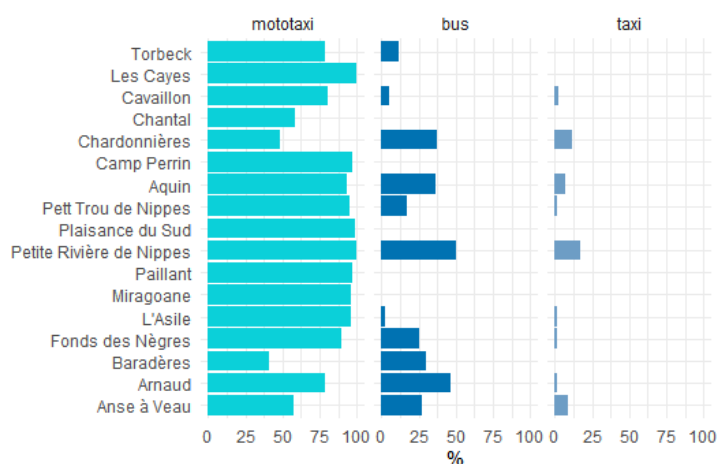


Figure 7: Availability of public transport by mode and Commune (% of respondents)



Based on the data collected during the 2022 survey, several logistic regression models were developed to look at the statistical relationship between various health related behaviors and the respondents' mobility constraints while controlling for basic socio-economic characteristics. Coefficients estimated using logistic regressions are called odds ratio and can be defined as "the predicted change in odds for a unit increase in the predictor" (CFDR, 2006).

The first outcome of interest is ***whether a respondent in need of medical care in the last 6 months received such care from a health facility (yes/no)***. As shown in Table 2.1 in Annex 2, controlling for the respondent's gender and number of children in the household, *not* owning a private means of transportation is associated with a statistically significant 78-percent decrease in the odds of having received medical care from a health facility in the previous 6 months; on the other hand, having access to functional public transport is associated with a doubling in the odds (although the result is only marginally statistically significant). The interaction terms between the respondent's gender and access to private or public transport is not significant, suggesting that the impact of transport access on having been able to receive health care at a facility is not different between men and women.

The second outcome of interest is ***whether a woman respondent, either pregnant or who had given birth in the previous 6 months, benefitted from prenatal medical services during that period (yes/no)***. The results suggest that, controlling for the woman's socioeconomic characteristics (education, income), there were significantly higher odds (between 8 and 10 times, depending on the model) of having had access to prenatal medical services if the respondent had continuous access to functional public transport in the previous 6 months. None of the socio-economic characteristics themselves seem to have a significant impact (Annex 2, Table 2.2).

The third outcome explored in the logistic regression analysis is ***whether a woman respondent, either pregnant or who had given birth in the previous 6 months, missed at least one prenatal consultation over that period (yes/no)***. Possibly because of the small sample size available specifically for this question (<100 observations), the regression results do not indicate that there are factors that are statistically strongly associated with this outcome. The odds of having missed an appointment are about 72 percent lower for women who had continuous access to functional public transport in the previous 6 months, but the result is very marginally statistically significant (Annex 2, Table 2.3). Neither the woman's education nor income appear to have a significant impact.

When asked about critical needs that would facilitate access to health care, nearly all (97 percent) of the 2021 survey respondents mentioned '*having a health center/facility closer*' and 58 percent of those ranked it as the top need. In the follow-up study, it was mentioned by 80 percent of respondents, below "*better road quality*" which was mentioned by 83 percent of respondents, but it remained the most frequently reported top need. The third and fourth most frequently reported needs to facilitate access to health care noted in the follow-up survey were "*access to means of transportation*" (28 percent of respondents) and "*better road lighting*" (19 percent).

4.2.2. *Schooling*

According to the conducted qualitative interviews with development organizations on the ground, in rural areas, the distance to school can either force the child to stay at home or discourage parents because of the risks the children could be confronted with while going to school. Children need to walk very long distances. Safety along the roads is also an issue, particularly affecting the girls' likelihood of attending school.

"Girls are now more exposed. For example one school that used to give classes in the morning, now give classes in the afternoon so there are some parents that decide that their children cannot go to school because of safety"

issue. Girls need to walk to school, and now classes end up being late, so there is a risk in certain areas. We have seen that in certain areas of the Grand Sud area, there were a lot of banditry around schools."

[UNICEF (Translated from French)]

The household surveys implemented as part of the study confirm that the most common means of transportation is walking: in the baseline study, approximately 70 percent of children went to school mainly by foot and 24 percent mainly by motorcycle, while in the follow-up study, 83 percent of children went to school mainly by foot and 14 percent mainly by motorcycle. According to both survey rounds, about three-quarters of the respondents named *"flooded roads"* as a constraint for the household's children to attend school.

Logistic regression analysis was implemented to examine the statistical relationship between schooling related behaviors and the respondents' mobility constraints while controlling for basic socio-economic characteristics. The first outcome of interest was ***whether school-aged children missed school at least once in the previous 6 months due to accessibility reasons (yes/no)***. Controlling for the respondents' socioeconomic characteristics, having had continuous access to functioning public transport has a statistically significant impact on the odds of having missed school at least once in the last 6 months: depending on the model specification, the respondents who had such access had between 58-percent and 79-percent lower odds of their children having missed school (see Table 2.4 in Annex 2). Reported travel time to primary school above 30 minutes is associated with a 110-percent increase in the odds of children having missed school, while reported travel time to secondary school above 30 minutes is associated with a 58-percent increase in the odds of children having missed school. The household *not* owning a means of transportation is associated with a statistically significant increase in the odds of children having missed school of between 50 and 63 percent, depending on the model.

Several socio-economic characteristics of the respondent's household also matter, such as household size and income. Each additional child in the respondent's household is associated with a 17-percent increase in the odds of any of the children having missed school. In addition, being in the high-income category (the household earning, on average, more than 15,000 HTG per month) is associated with a 41-percent decrease in the odds of children having missed school.

Similarly to access to health care, when asked about what would make the biggest difference for improving school accessibility, the most frequent answer was *"better quality roads"* (mentioned by 83 percent of respondents from households that had children going to school), followed by *"a school closer to home"* (61 percent) and *"access to means of transportation"* (30 percent).

4.2.3. Livelihood opportunities

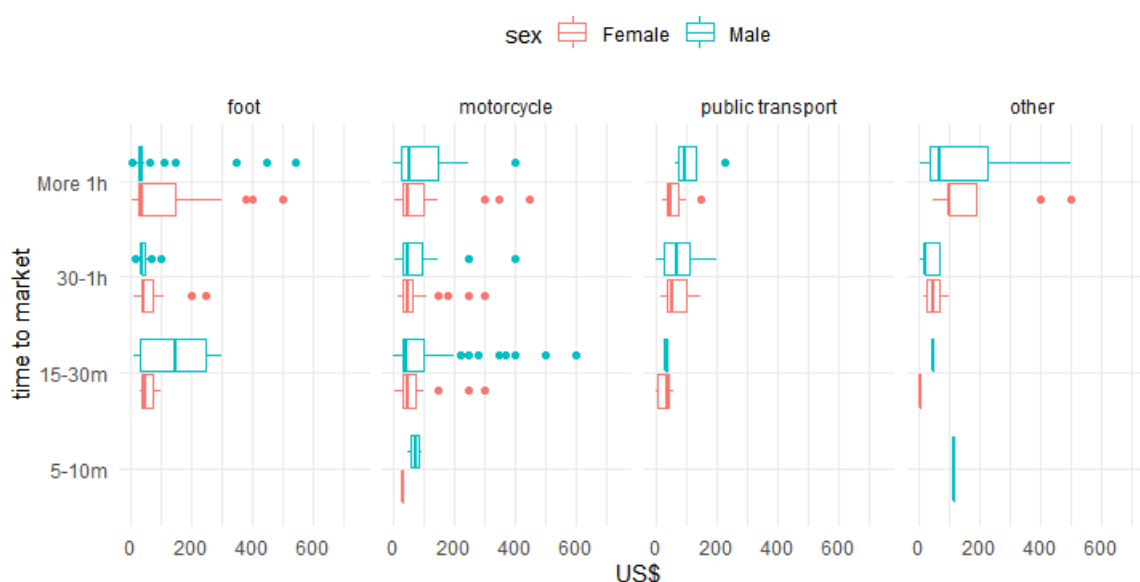
With respect to market access for agricultural products, there are some differences between the two household survey rounds implemented as part of this study, possibly indicating the impact of the earthquake on overall livelihood security in the study area. Indeed, of the households that did not sell any of their agricultural production in the previous 6 months prior to the 2022 survey, 88 percent reported *"not enough volume/quantity produced"* as one constraint. On average, a lower share of farmers sold some or all of their produce in 2022 than in 2021 (likely due to needing it for own consumption), and the average earnings from sales were also lower.

In the 2021 survey, respondents were asked about the exact place where they go to sell their products. This answer was captured as text, with a variety of responses; approximately 59 percent of the responses could be matched to a specific market. Of all the respondents who produce any agricultural goods and sell at least some, 63 percent do *not* sell in their closest market, with no significant differences between men and women but the *"no"* group being composed of higher income respondents compared to the *"yes"* group. The farmers that do not sell their produce at their closest market are, on average, farther

from their market than the ones who go to their closest market. The average distance traveled for the group that sells at the market nearby is approximately 4.5 km while for the ‘no’ group it is 5.7 km, the difference being statistically significant. In both cases, about three-quarters of people take their produce to the market using motorcycles.

It appears that the choice of traveling further to sell is driven by the price that can be obtained: the average for the group that sells in their closest market is smaller than for the group that travels farther, and the average earnings of those who travel for longer time are higher than those whose reported travel time is shorter⁴ (Figure 8). Men appear to be more able to take advantage of the better earnings opportunities in the further markets, on average traveling longer time (Figure 8), and 43 percent of them traveling over an hour to sell produce, compared to 15 percent of women. Possibly this is because the travel difficulties (time costs, insecurity) imply a lower barrier for men than for women. However, even at the same reported travel time range, men appear to earn more than women.

Figure 8: Reported time to market for respondents who sell crops and associated earnings per month, by mode and gender



Source: Survey collected by the study team in April 2021; Note: boxes show 25th-75th percentile (the line represents median)

The second round survey (2022) asked about the specific barriers to selling produce in markets. Among the households that had sold at least part of their agricultural production in the previous 6 months, “*poor state of roads*” was mentioned by 82 percent, ranking as a top issue for 76 percent of them, followed by “*transport services are costly*” (59 percent) and “*goods were damaged*” (32 percent). “*Transport is not safe – traffic accidents*” was mentioned by 7 percent as one of the key issues.

A logistic regression model was developed to understand whether mobility related factors are statistically associated with ***the farmer respondents having sold any harvest during the previous 6 months (yes/no)***. In this case, the respondent’s household having no own means of transportation does not appear to have a significant effect, nor do any of the tested socioeconomic characteristics (Table 2.5 in Annex 2).

However, according to the interviewed humanitarian and development organizations on the ground in Haiti, lack of safe transport does present a barrier particularly for women to be able to access markets and sell produce, since most women do not own a vehicle and public transport services are provided

⁴ According to the exchange rate in mid-December 2021.

mostly by motorcycle. A priori, these are services offered by men and are noted to be unsafe. Indeed, as also suggested by the household survey responses presented earlier, alternatives to motorcycle-based taxi – such as bus or communal taxi services – are scarce in most of the communes in Nippes and Sud.

4.3. Broader access barriers, especially for individual marginalized groups

4.3.1. Health care

Of the 274 respondents surveyed in 2022 who had been treated in a health care facility in the previous 6 months but had not attended the facility closest to their homes, issues of availability (*“services not offered”*) was mentioned by 70 percent of them, followed by *“low quality”* and *“waiting time too long”* mentioned by 18 percent and 13.5 percent of them, respectively) and affordability (*“expensive services”* was mentioned by 18 percent) were more prevalent than issues of transport accessibility. Of the women who had given birth in the previous 6 months (2 percent of the entire sample surveyed in 2022), 20 percent had not had access to post-natal care. Among those women, issues of availability (*“too far”* and *“waiting time too long”* were both mentioned by 44 percent) and affordability (*“expensive services”* was mentioned by 33 percent) were prominent.

The interviews conducted with the humanitarian and development organizations working on the ground in Haiti revealed several types of barriers for accessing health care services in rural Haiti that go beyond transport accessibility and especially affect certain marginalized groups.

The overall cost – considering the health care and transport services – was noted as a challenge to accessing health facilities. It was mentioned that many women would avoid going to a health facility to give birth because it is too expensive. The cost of traveling to health facilities also deters women's attendance. The further one goes inland to more rural areas, the access is more limited, in contrast to those who are in the city center, where access to basic services is easier. However, the direct costs are not the only ones incurred by households to access services. There are large opportunity costs in terms of foregone income and direct costs associated with the service itself.

“What they will pay is not really what the cost of the service will cost but the accumulation of all of these surrounding costs. For example cost to go to the facility, the cost of the service, the time they spend to wait to have the service, and what they lose by going to these facilities and not working. [...] You will realize that some of the population might be more affected than the other. For example, if you take a poor small farmer that is at the same time a single mother. [...] If this person goes to invest her remaining savings, 500 goudes, in a health services of 200 goudes, it is indeed a hard decision to make.”

[Care Haiti]

The quality of care is low and varies significantly: the further one goes into rural areas, the lower the quality of care because of the lack of retention of physicians, quality of professionals, and access to materials, even basic items like fuel for generators; these issues have a direct impact on the quality of care that is offered to residents in an around that area.

“It is very hard especially in public facilities to find high standard. Therefore there is a big gap between the public or state owned health facilities and the privately managed facilities. And this affects how people relate with health facilities. It could happen that people prefer to commute 5 kilometers instead of 2 kilometers to avoid a facility in particular. If they feel maltreated, people won't go back to that facility.”

[Care Haiti]

Because of the lack of prenatal care infrastructure, less than 30 percent of women go to more than one prenatal visit. In Haiti, the reliance on community groups is important. There are institutions that train networks of traditional midwives to be specially based and available in very secluded, rural areas where the nearest health facility is a certain number of miles away. However, according to Partner's in Health interviewee, there are also gaps in health services for survivors of gender violence.

“There are minimal health facilities that you could actually have a safe labor and delivery [...]. You know the vast majority of health facilities in Haiti do not have adequate water or sanitation and or sterile environments. [...] When you look at facilities that you can have a vaginal birth and/or a c-section out of 904 facilities there were only 30 sites in the whole country that were registered and able to perform a c-section.”

[Partners in Health, Zanmi La Sante]

“In Haiti, there are dispensaries, health centers (without beds and with beds), community reference hospitals, etc. However, for the number of inhabitants, the number of community reference hospitals is not enough. In case someone needs to be referred to a hospital (e.g. to Jeremih), distances are significant, hence a complication for the patient to access those services.”

[GRET (Translated from French)]

People living with a disability in Haiti are not registered in the public records, and, consequently, are cut off from the health care system, as noted by the representative from Partners in Health. Moreover, the infrastructure of most hospitals is not fit for their necessities. The surveys implemented by the study team asked if the respondents are living with any type of disability, including visual, auditive, mobility difficulties, difficulty taking care of themselves, and difficulty concentrating. Aggregating the disabilities into a single variable, approximately 20 percent of the respondents reported living with at least one disability in the 2021 survey sample and 30 percent in the 2022 survey sample, with balanced responses between men and women. When asked about difficulties with accessing health care services, about 3 percent of the overall sample mentioned their disability(ies) as among the key reasons, but the share was twice as high among the female respondents in the Sud department specifically. Women in general were also more likely than men (8.2 percent vs. 5.7 percent) to name personal constraints as a barrier for accessing health care, including difficulties of movement associated with a disability, inability or lack of permission to travel alone, lack of childcare, and inability to leave work.

4.3.2. Schooling

School quality – or lack thereof – was noted as a barrier to schooling access in the household surveys implemented by the team: approximately one-third of respondents said that there is a primary school closer to the one that the children attend, most of them living in L’Asile. The main reason they gave is that the school closer to them is of poor quality.

Although Haiti has signed and ratified major international and regional treaties that promote human rights, including gender equality, the country still experiences gender discrimination and stereotypes (OHCHR, 2022). Sexual violence impacts various aspects of girls’ lives, including in education, where sexual harassment is common, including while en route to schools and other facilities (UNOCHA, 2022). In the case of schooling, the interviewed development and humanitarian organizations noted several barriers beyond transport accessibility and affordability. A key aspect that was noted was the differences between boys and girls in accessing education from an early age. For example, because of early pregnancy, it is common to see girls not concluding their education.

“Unfortunately, still, until this date, if families can only send one child, they will prioritize sending boys. As we advance, through the whole education cycle and then access to jobs, we can identify very clear differences.”

[Concern]

“It must be said that for girls, very often, even if there is an effort being made to change this, generally, we prioritize the education of boys when we have limited means. We have real difficulties in covering school fees. [...] In rural areas there is a problem of access, due to the low number of public schools.”

Similarly, it was noted that children living with a disability do not commonly attend school. According to the interviewed UNICEF representative, because of social norms around disabilities and shame, families commonly keep such children at home.

4.3.3. Livelihood opportunities

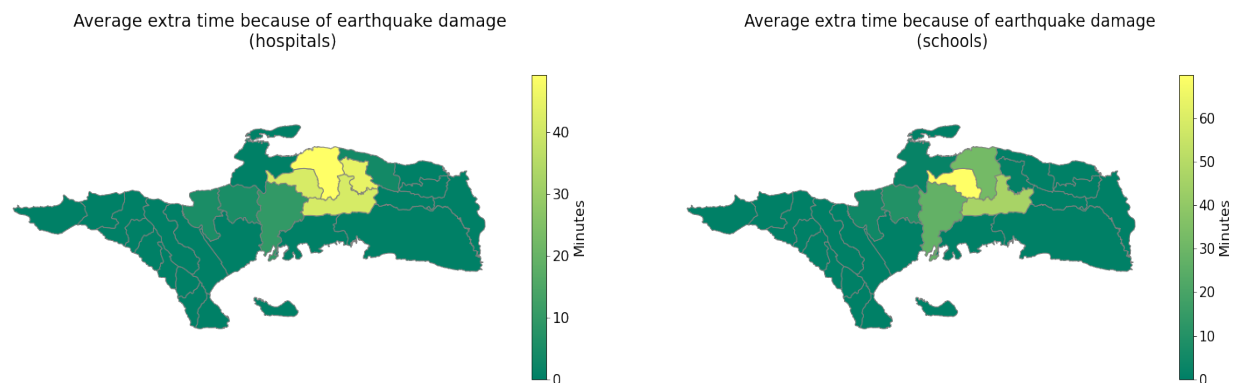
Men and women in rural Haiti tend to access the same markets, but the risks are significantly different. The interviewed humanitarian and development organization staff noted that all merchants face the risk of robberies because of the presence of armed groups. However, as demonstrated by research on the ground, such as by Care Haiti's gender-specific road risk assessment in the municipality of Jeremih, women face additional protection risks, such as of sexual assault.

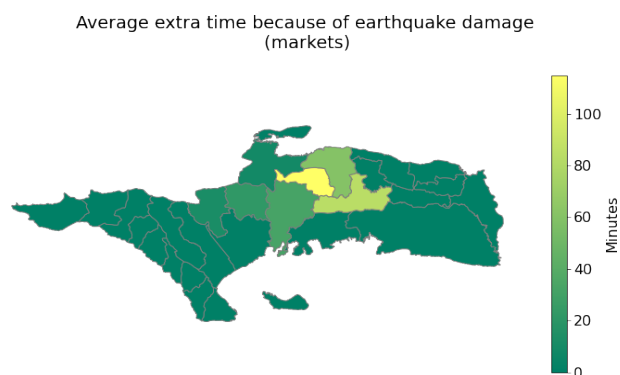
Moreover, time poverty and many competing responsibilities affect women's ability to choose well-remunerated livelihood opportunities. In Haitian households, most of the responsibility falls on the woman, and these household duties have a significant impact on women accessing work. Very few people have access to formal employment in the most remote areas of the Grand Anse; most are engaged in agricultural activities. Therefore, these activities are limited in terms of income.

4.4. The additional impact of the earthquakes

The roads identified in the team's spatial analysis to have a high criticality index are either paved roads (which therefore are nearly always part of the most efficient path to get to a service) or roads that connect different sections of the road network. The main difference between the criticality computed for hospitals and for schools is that unpaved roads outside of the primary network have a higher criticality index for hospitals (see the slightly more pink hue in inland roads for hospital criticality in the maps above). This is natural: these roads are less important for schools, because one is more likely to have a school in remote communities than to have a hospital in the same community. The regions where access to hospitals was already poor prior to the August 2021 earthquake (Plaisance du Sud, Petit Trou de Nippes and Grand Boucan) are also the ones that were most impacted by the earthquake, leading to increases in travel time by over 40 minutes in these regions. Also in the case of schools and markets, the earthquake-induced extra travel time is the highest in the communes near Plaisance du Sud (Figure 9).

Figure 9: Extra time needed to reach a hospital (left), school (right), or market (bottom), considering earthquake damage





Source: Findings by study team

4.4.1. Health care

According to the interviews with development organizations on the ground, the earthquake particularly affected some of the key transport links between population centers and health facilities. And, while already before the earthquake access to assistance and basic services was generally very limited (facilities in the Grand Sud were damaged or completely demolished due to Hurricane Matthew and others), the earthquake in August of 2021 destroyed many more facilities, and few institutions providing psychosocial and legal services for the entire South remained for cases of GBV or other related risks. Care also became more limited for specific vulnerable population groups such as people living with HIV/AIDS.

“After the August 2021 earthquake, the bridge in and out of Jeremih was out of use, and one could not get in and out unless they had a massive truck. Only way to access healthcare was to go to Les Cayes or Fonds des Blancs. Most people make less than \$2/day and could not afford to go to health facilities because they still have to feed their kids. [...] The earthquake in August of 2021 also destroyed dozens and dozens of health facilities, even the most basic dispensary, you know that provided childhood vaccine or rehydration and or family planning. [...] Individuals who are HIV positive or who have AIDS. [...] Those individuals, especially when you look at a situation like after the August 2021 earthquake where now the health facilities where they picked up their antivirals or they were really getting their viral loads checked no longer exist.”

[Partners in Health, Zanmi La Sante]

The additional impact of the earthquake on the already difficult access to health care services is also reflected in the household survey responses: 12 percent of the entire sample of the survey implemented in 2022 perceived ‘*earthquake-related road damages*’ as a constraint to accessing health care in the previous 6 months. In terms of *behaviors*, of the 274 respondents who had been treated in a health care facility in the last 6 months but had not attended the one closest to their homes, about 2 percent mentioned earthquake-related road damages as a reason for not attending the nearest facility, and about the same percentage mentioned that the “*nearest clinic was damaged by earthquakes*”). Of the women who had given birth in the previous 6 months prior to the implementation of the 2022 survey, 20 percent had not had access to post-natal care; of these, 11 percent mentioned earthquake-related road damages as a reason.

As shown by the logistic regression models in Annex 2, the odds ratio for being in the treatment group – i.e., living in SDEs directly affected by the earthquake damage to roads – is statistically significant, associated with a 63-66 percent decrease in the odds of having received medical care from a health facility in the previous 6 months (among those who responded that they needed such care), controlling for the respondents’ socioeconomic characteristics and public and private transport access. However, in the regression models specific to women who were pregnant during the previous 6 months, being in the

treatment group does not appear to have a statistically significant association with either having benefitted at least once from prenatal medical services during the previous 6 months or having missed a prenatal appointment. As noted before, the sample size of the latter two models is less than 100, which may partly explain the lack of a significant result.

4.4.2. *Schooling*

The interviewed representatives of local development and humanitarian organizations noted that the earthquake affected numerous educational structures. Prior to full reconstruction being possible, quick measures had to be taken to facilitate the reopening of classes, but it was not possible to restore classes for everyone even six months later. Because of school scarcity, some educational centers created a system where they impart classes to their official students in the morning, and then open a second shift in the afternoon, for children of other schools that haven't reopened yet. The interviewed organizations also noted that, in the aftermath of the earthquake, people prioritized survival and rehabilitation process over education. The earthquake also prompted many people to migrate away from their homes, implying added difficulties for children's continued access to schooling: they either moved to live in nearby camps (in the Grand Sud area) or further afield (outside the Region). For those families who were closer to their former household, it was easier. However, other families had to move without knowing if they were going to find an educational center for their children.

"More than 12.000 schools were damaged. As for now, there are some schools in the Grand Sud, that work as a center for 2 schools at the same time. So basically, some of them give classes only the morning, to give the opportunity to another school that was damaged to also give classes."

[UNICEF (Translated from French)]

"We had to set up temporary structures to accommodate the children, which was one of the major challenges for the government. We couldn't really put in place structures to allow all the children in school to return to school."

[Action Aid (Translated from French)]

The representative from Action Aid also noted that the earthquake affected the girls' schooling more than the boys': while already being a more vulnerable group because of the existing social, economic and political inequalities, the girls are often the first to suffer the consequences of natural disasters, because they are generally called upon to take charge of the survival of their families. So generally they will have to leave school to help take care of others, support the family, do household chores.

According to the household survey implemented in 2022, about 14 percent of the households that had girls going to school in the previous 6 months and 15 percent of the households that had boys going to school over the same period reported that "*earthquake-related road damages*" were one of the five main constraints faced by children to access school. However, this was most likely a temporary constraint, as no household where children were *not* attending school mentioned earthquake-related damages (either on the road, or on the school itself) as a justification. Of those households that said they send their children to a primary school that is not the nearest to their home, few (<2 percent) reported that it was because the nearest primary school was closed because of earthquake-related damages. Similarly, of the households that did not send their children to the nearest secondary school, less than 1 percent reported that it was because the nearest secondary school was closed because of earthquake-related damages.

The logistic regression results presented in Annex 2 Table 2.4 suggest that, controlling for the respondents' socioeconomic characteristics and transport access, living in an SDE affected by earthquake related road damage is associated with a statistically significant 110-percent increase in the odds of children having missed school at least once in the previous 6 months.

4.4.3. *Livelihood opportunities*

Among the households that had sold at least part of their agricultural production in the previous 6 months prior to the 2022 survey, 7 percent reported “*earthquake-related road damages*” as one of the issues faced when transporting goods. This issue, however, was one of the least frequently reported. Of the households that had not sold any of their agricultural production in the previous 6 months, only one respondent mentioned that the “*nearest market was closed as a result of earthquake-related damages*”, and three also noted that “*earthquake-related road damages*” as a constraint.

According to the regression analysis, controlling for the respondents’ socioeconomic characteristics, production of cash crops, and owning any private means of transport, living in the earthquake-damaged road vicinity is associated with a statistically significant 38-percent decrease in the odds of having sold any harvest in the previous 6 months.

4.4.4. *The spatial patterns of transport related constraints to access*

Analysis was conducted based on the second survey round to identify spatial patterns in the reported accessibility constraints in general to help guide and prioritize future investments in the area. The circled clusters of responses demonstrate where transport related accessibility constraints related to health, education and markets seem to be concentrated. A proxy variable for the state of roads in the dataset was developed, for which the enumerators (not respondents) were asked to report the state of the surveyed household’s nearest road using the following scale: “very poor”, “poor”, “fair” and “good”. Figure 10 shows the SDEs whose roads are estimated to be affected by the earthquake damage (treatment) and those not (control), and the share of households in each of them for which the state of the nearest road was assessed to be “very poor” or “poor”, as well as the share of households in each SDE reporting no access to continuous functional public transportation during the previous 6 months. In terms of access to health, Figure 11 shows the reported state of the nearest road using the same scale and also includes a scale that corresponds to the share of households in each SDE ranking ‘better road quality’ as the top need to facilitate access to health care.

As shown in Figure 10, the share of roads assessed to be in poor or very poor condition by the survey enumerators is high in several areas of the study region, not only in the areas (“treatment” areas) where roads are estimated to be damaged by the recent earthquakes. In this case, the most important metric represented in the map is the respondent-reported lack of continuous functional public transportation in the previous 6 months, for which particularly high values (>60 percent) appear to be clustered around a single road. As shown in Figure 1.1 in Annex 1, the road is also estimated to have a high criticality index, both for hospital and for school access, meaning that a high fraction of the shortest paths going from population settlements to hospitals/ schools include the specific road. The specific road and its direct vicinity are not estimated to be damaged by the recent earthquakes but, due to its already poor condition, the road was intended to be rehabilitated by the World Bank financed rural roads project. The poor road condition, rather than any further earthquake-related damage, likely explains the lack of public transport services.

Further, when asked specifically about the road infrastructure quality, the share of survey respondents reporting “better road quality” as the single most important priority for accessing health care services exceeds 60 percent in three main spatial clusters of SDEs (Figure 11). One of them corresponds to approximately the same area as in the case of the reported lack of continuous functioning public transport services (in southeastern Nippes). The second is an extended area in northwestern Sud, where, in fact, not all SDEs are assessed by the survey *enumerators* to have particularly poor quality roads. The third, smaller, cluster is located in southeastern Sud, where also the survey enumerators assessed that over 80 percent of the respondents in each SDE live near roads of “very poor” or “poor” quality.

Figure 10: State of the nearest road and access to continuous functional public transportation

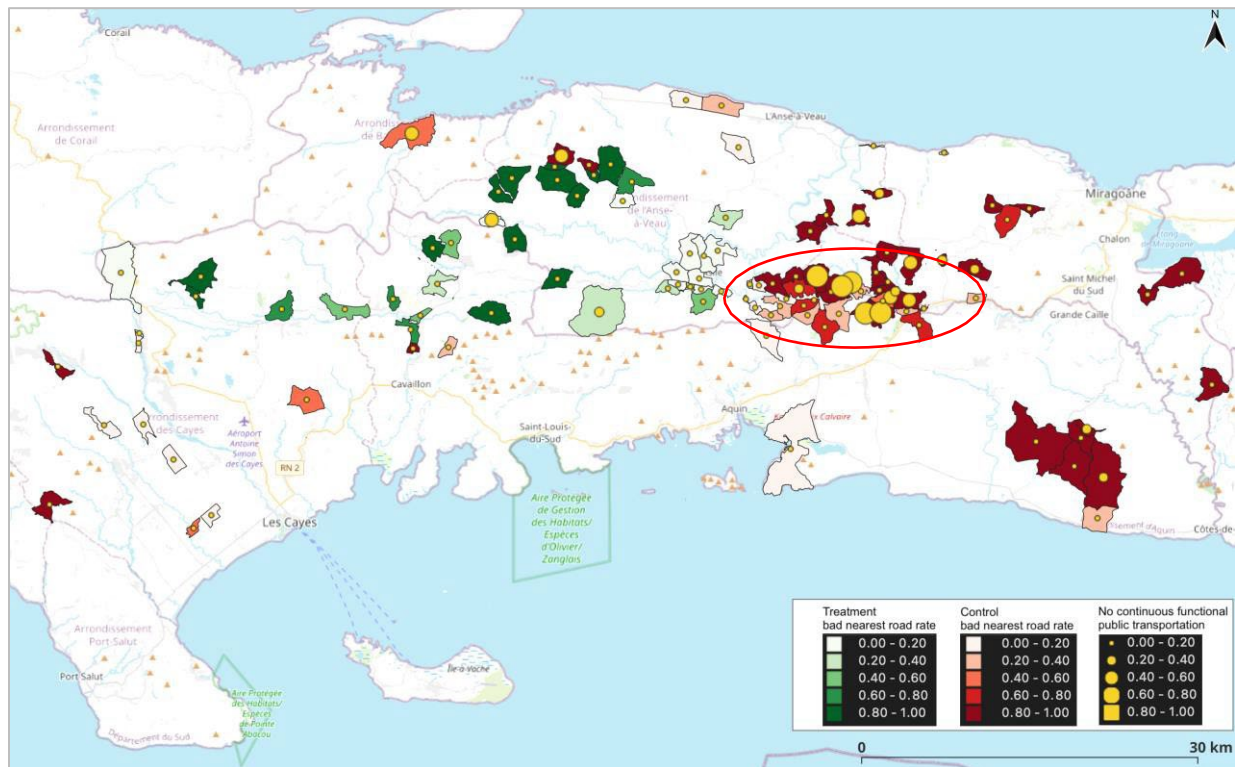
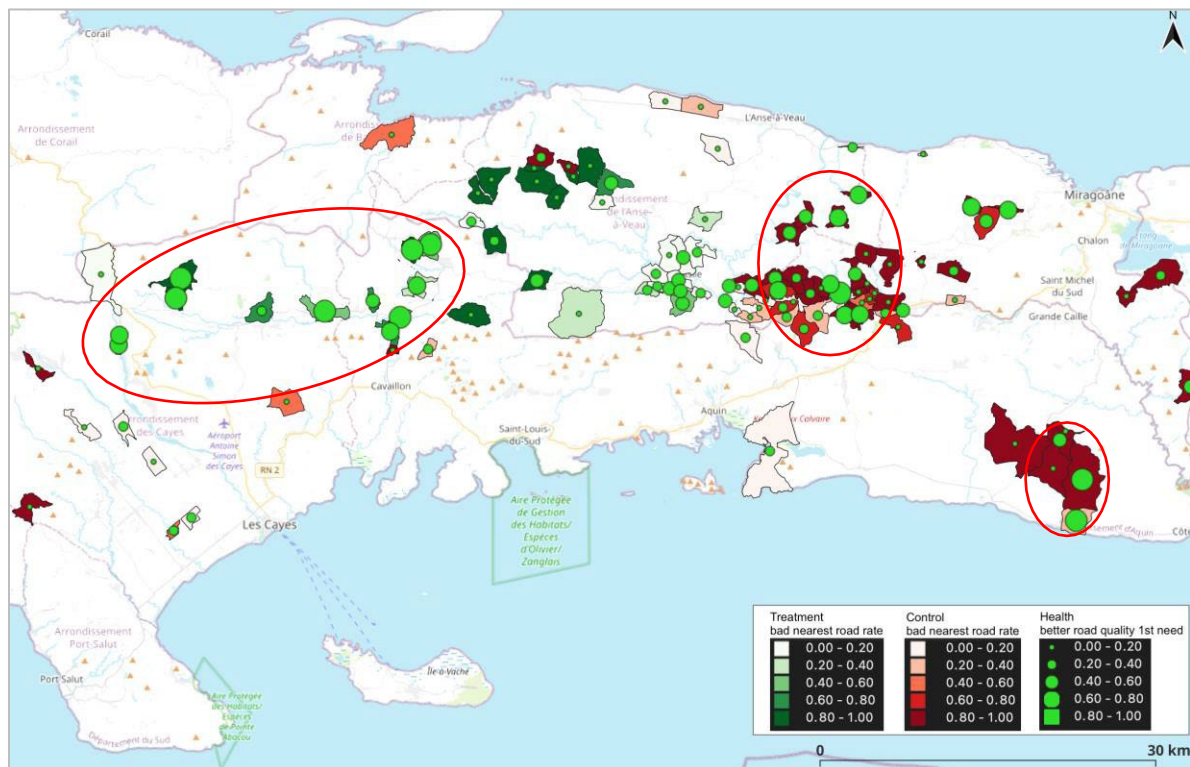


Figure 11: State of the nearest road and “better road quality” as the top reported need for accessing health care



Source: Household survey implemented by the study team in July-August, 2022

5. Conclusions and policy implications

Several socioeconomic characteristics of the respondents or their households appeared to matter for the analyzed health, schooling, and market access behaviors. Households with more children were more likely to have at least some of the children miss school in the previous 6 months, while being in the high-income household category was associated with lower such odds. On the other hand, the respondent's gender and age did not appear to be statistically associated with having received health care at a facility, the household's children having missed school, or the respondent having sold any harvest at a market. Similarly, neither for these behaviors nor those specifically relevant for women who were either pregnant or gave birth in the previous 6 months did the respondent having earned their own individual income or having received any formal education appeared to have an effect.

Understanding how rural road accessibility improves household and, specifically, women's welfare, via access to health care, schooling, and livelihood opportunities is essential for designing gender-informed projects. This study can also inform policy makers in Haiti on whether the road infrastructure is leading to equitable access or if additional interventions are necessary to increase the impact of road rehabilitation on the health, schooling, and economic behaviors of specific population groups such as women. Based on both rounds of surveys, **transport infrastructure and complementary interventions are perceived as important for households to access health care, schooling, and livelihood opportunities, and matter for their actual behaviors.** According to the statistical models, not owning a means of transportation is associated with a decrease in the odds of having received medical care from a health facility in the previous 6 months (among those who reported needing it) and increase in the odds of children having missed school at least once during the same period. Having continuous access to functional public transportation is associated with significantly higher odds of having received prenatal medical services in the previous 6 months among those women for whom these services were relevant and with lower odds of children having missed school. Travel time to either primary or secondary school in excess of 30 minutes increases the odds of children having missed school. The vast majority of the people surveyed mentioned *'having a health center/facility closer'* and *"better quality roads"* as the top needs for being able to access health care services. However, the responses also indicate the need for complementary interventions, such as in transport services, and attention to specific road characteristics, such as improved lighting/safety while using the road. Similarly, for improving school accessibility, the respondents most commonly named *"better quality roads"*, followed by *"a school closer to home"* and *"access to transportation"*.

According to the interviews conducted by the study team with a range of international and local humanitarian and development organizations on the ground in Haiti, several transport related interventions would make a difference in improving access for the most vulnerable population groups:

- There is a need to improve the road infrastructure to enable more transport alternatives to become available, and work with service providers on the roads to improve the transport service quality. Inter-communal and inter-departmental transport services are needed: the introduction of tap-tap or van services could help reduce the risk of accidents when taking motorbike taxis.
- Women could be more integrated into the transport system as transport services providers, which would reduce some of the risks. There could also be collectives of transport providers (including men) who are trained and sensitized against violence against women. A female customer would then feel secure if she took a taxi from that organization.
- There is a need to bring services closer to people, invest in locally based facilities. The distance people commute to get to a particular service facility or to get employment opportunities directly impacts people's willingness to travel.

The August 2021 and January 2022 earthquakes seem to have affected some, but not all, of the reported health, education and accessibility constraints and actual behaviors in Sud and Nippes. In terms of actual behaviors, the earthquake damage to roads was associated with a decrease in the odds of having received medical care from a health facility in the previous 6 months (among those who reported needing it), increase in the odds of children having missed school at least once in the previous 6 months, and decrease in the odds of having sold any harvest in the previous 6 months (among those who reported farming as an income earning activity). On the other hand, for the women who were pregnant or gave birth during the previous 6 months, living in the earthquake damaged road vicinity does not seem to have affected their odds of having received prenatal care at a health facility during that time or having missed any prenatal appointments. Similarly, when asked about the relative importance of various constraints to access, roads being damaged by earthquakes was reported to matter for only a subset of the respondents. Overall, these findings are consistent with the other findings presented in this paper, namely that accessibility constraints in the survey area were significant to begin with and that recent earthquakes might have made those slightly worse but likely only temporarily. This is also in line with observations made by enumerators and supervisors during the survey data collection (in July-August 2022), which suggested that recent earthquakes did not significantly deteriorate the state of roads in the two departments of study compared to their already poor condition.

A general policy recommendation heard from the interviewed local humanitarian and development organizations regarding response following a natural disaster of this magnitude is to acknowledge the existence of community structures and work hand to hand with them. Deliberately seek out to those women and girls in communities at the time after a natural disaster hits, to identify the specific needs and how to set up services in a way that is accessible to them and considers their needs.

From the interviews with the development organizations in Haiti and the responses to the first survey which aimed to oversample women (including of reproductive age) and included more questions related to non-transport related barriers to accessing health care and schooling and livelihood opportunities, it is clear that **a broader set of interventions would be required to allow everyone, including the most marginalized groups, to gain full access to health, education, and livelihood opportunities** in rural Haiti. In the existing literature, initiatives that have been found to bolster women's employment include offering childcare, supporting gender-blind hiring and selection criteria allowing for lower education levels, and supporting their transport to employment (Gandini et al., 2021). The interviewed representatives of humanitarian and development organizations in Haiti also noted the need to work on people's beliefs and perceptions around certain topics, such as disability. This could have a positive impact on one group of the community that is constantly discriminated against and therefore does not have the same access to education, health, and/or job opportunities as the rest of the population. Specific solutions could include having advisory committees of local people living with a disability, because there isn't going to be a one-size-fits-all answer depending on how the community is constructed.

References

- CEDAW Committee. (2016). Concluding Observations on the 8th and 9th periodic reports, Haiti, March 9, CEDAW/C/HTI/CO/8-9, <https://www.ohchr.org/en/documents/concluding-observations/cedawchtico8-9-concluding-observations-combined-eighth-and-ninth>
- CFDR. (2006). Annotated Output – STATA. Center for Family and Demographic Research. <https://www.bgsu.edu/content/dam/BGSU/college-of-arts-and-sciences/center-for-family-and-demographic-research/documents/Help-Resources-and-Tools/Statistical%20Analysis/Annotated-Output-Logistic-Regression-STATA.pdf>
- Gage, A.J. and G. Calixte. (2006). Effects of the physical accessibility of maternal health services on their use in rural Haiti. *Population studies*, 60(3), pp. 271-288.
- Gandini, C., A. Silva, P. Guerrero. (2021). Gender and Transport in Haiti. Inter-American Development Bank, February 2021.
- Human Rights Council. (2022). Working Group on the Universal Periodic Review, Fortieth Session, *Compilation on Haiti*, A/HRC/WG.6/40/HTI/2, <https://documents-dds-ny.un.org/doc/UNDOC/GEN/G21/321/49/PDF/G2132149.pdf?OpenElement>
- Human Rights Watch. (2022). World Report, Events of 2021, Haiti. At: <https://www.hrw.org/world-report/2022/country-chapters/haiti#:~:text=Haiti's%20prisons%20remain%20severely%20overcrowded,of%20whom%20were%20awaiting%20trial>
- Immigration and Refugee Board of Canada. (2017). Haiti: Situation of Women who live alone, including those who are not in precarious situations, October 17.
- Ndambukia, D., H.K. Al Hitmib. (2021). *Transportation planning and resilience in countries with high risks of natural disasters: The case of Haiti*, November 17, available at SSRN: <https://ssrn.com/abstract=4008746>
- OHCHR. (2022). Universal Periodic Review of Haiti, 3rd Cycle - 40th Session, Thematic list of recommendations, January 31, <https://www.ohchr.org/en/hr-bodies/upr/ht-index>
- Perge, E. and S. Touray. (2017). *Transport and Poverty in rural Haiti. Existing Evidence from Household Surveys*, December.
- Raymondville, M., Rodriguez, C.A., Richterman, A, et al. (2020). Barriers and facilitators, Influencing facility-based childbirth in rural Haiti: a mixed method study with a convergent design, *BMJ Global Health*, 5. doi:10.1136/bmjgh-2020-002526.
- Sowah, L.A., F.V. Turenne, U.K. Buchwald et al. (2014). Influence of transportation cost on long-term retention in clinic for HIV patients in rural Haiti. *J Acquir Immune Defic Syndr*. 2014 Dec 1;67(4):e123-30.
- UNOCHA. (2022). *APERÇU DES BESOINS HUMAINITAIRES, HAÏTI*, March, available at <https://reliefweb.int/report/haiti/haiti-aper-u-des-besoins-humanitaires-2022-mars-2022>
- UNOCHA (2023) Haïti : Analyse IPC de l'Insécurité Alimentaire Aiguë Snapshot | septembre 2022 - Juin 2023. Available at : <https://reliefweb.int/report/haiti/haiti-analyse-ipc-de-linsecurite-alimentaire-aigue-snapshot-septembre-2022-juin-2023>
- U.S. Department of State. (2022). 2021 Country Reports on Human Rights, April 12, <https://www.state.gov/reports/2021-country-reports-on-human-rights-practices/haiti/>
- U.S. AID (2011) *Mangoes and Tees: the Next Phase of Haitian Recovery?* Available at: <https://2012-2017.usaid.gov/news-information/frontlines/haitiwomen-development/mangoes-and-tees-next-phase-haitian-recovery>
- World Bank Group. (2022a). *Haiti Country Overview*. Washington, D.C., [https://www.worldbank.org/en/country/haiti/overview#:~:text=The%20World%20Bank%20Group%20\(WBG,p eople%20and%20to%20combat%20poverty](https://www.worldbank.org/en/country/haiti/overview#:~:text=The%20World%20Bank%20Group%20(WBG,p eople%20and%20to%20combat%20poverty)
- World Bank Group. (2022b). *Country Diagnostic, Haiti*, June, Washington, D.C.

Annex 1: Data sources and preparation for the spatial accessibility and criticality analysis

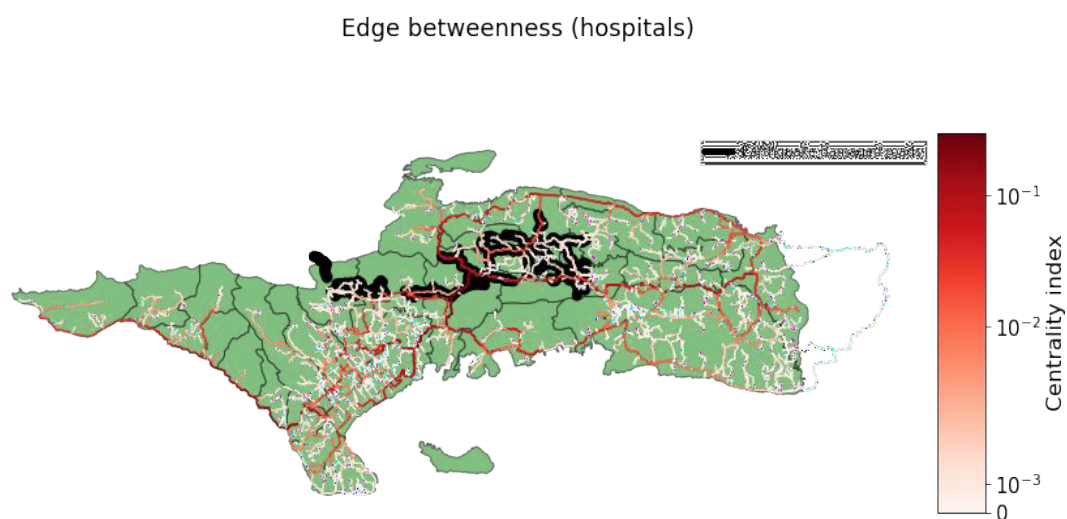
The main road network was obtained from a past World Bank project. The original shapefile contained information on the average speed corresponding to each road segment, ranging from 25 km/h to 60 km/h. Although this dataset contains most of the major paved and unpaved roads, many rural paths are missing. Therefore, the dataset was complemented with data from OpenStreetMaps (OSM) – roads more minor than primary or secondary. The following speeds were assumed for these additional roads: (i) Tertiary: 30 km/h, (ii) Track: 10 km/h, and (iii) Unclassified and path: 5 km/h. The merged network contained 829 km of paved roads and 9,061 km of unpaved roads.

Population. The accessibility computations require as input a set of points in a map corresponding to human settlements, along with the population that lives there. To obtain this, a map of populated places was obtained from OSM, along with data from <https://www.worldpop.org/>. WorldPop data consists of a raster with population density, which were used to attribute populations to each OSM “place”. The population corresponding to each pixel in the raster was evenly assigned among the settlements that lay inside the pixel, and, in the case where there are no settlements inside the pixel, the population was attributed to the nearest points. In total, this allowed distributing the roughly 1 million people that WorldPop estimates lived in Sud and Nippes in 2020 among 1,374 settlements.

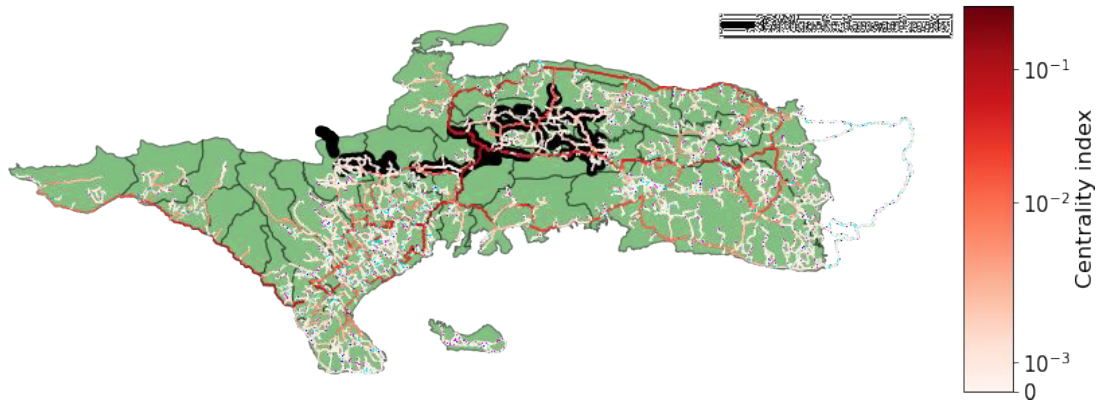
Target locations. GPS locations of hospitals and schools had been collected as part of previous World Bank projects. Overall, the dataset has 33 hospitals and health centers across Sud and Nippes, as well as 437 public schools and 1,738 private schools. Similarly, market locations are available from World Bank project data collection done previously.

Transforming the road network. The maps were transformed into *networkx* (<https://networkx.org/>) networks using a modified version of GOSTNets, <https://github.com/worldbank/GOSTnets>, which was adapted for use with the road data described above. Each edge in the network was attributed the time required to travel through it using the corresponding road distance and the corresponding speeds for each road category as defined above. Thus, the shortest path between two nodes in the network is defined as minimizing the time required to link them.

Figure 1.1: Road criticality indices for schools and hospitals



Edge betweenness (schools)



Annex 2: Detailed regression results

Table 2.1: Having received needed health care at a facility in the previous 6 months

"Received needed care at a facility in the past 6 months"	(1)	(2)
	Odds ratio	Odds ratio
Treatment group (1=yes)	.367 (.050) ***	.341 (.054) ***
Gender (1=woman)	.713 (.274)	1.006 (.451)
Number of children in household	1.047 (.038)	1.078 (.045) .
Household has no own transport (1=yes)	.219 (.072) ***	
(Gender) x (Household has no own transport)	1.832 (.753)	
Household had continuous access to functional public transport in previous 6 months (1=yes)		2.042 (.803) .
(Gender) x (Household had continuous access to functional public transport in previous 6 months)		1.097 (.524)
Constant	13.042 (4.310) ***	2.691 (1.028) *
Log likelihood	-651.751	-532.958
Number of obs.	1,220	1,070

Note: standard errors in parenthesis; constant estimates baseline odds

Table 2.2: Having benefitted at least once from prenatal medical services during pregnancy in the previous 6 months

"Benefited from prenatal care in the past 6 months"	(1)	(2)	(3)
	<i>Odds ratio</i>	<i>Odds ratio</i>	<i>Odds ratio</i>
<i>Treatment group (1=yes)</i>	.355 (.256)	.390 (.290)	.358 (.259)
<i>Has any formal education (1=yes)</i>	1.782 (2.224)	2.214 (2.916)	1.819 (2.285)
<i>Household earned, on average, 7,000-15,000 HTG per month in the previous 6 months (1=yes)</i>		.431 (.366)	
<i>Household earned, on average, >15,000 HTG per month in the previous 6 months (1=yes)</i>		1.427 (1.891)	
<i>Respondent earned any individual income during the previous 6 months (1=yes)</i>			.833 (.651)
<i>Household had continuous access to functional public transport in previous 6 months (1=yes)</i>	9.132 (6.878) **	10.448 (8.220) **	8.637 (6.797) **
<i>Constant</i>	1.319 (1.749)	1.409 (1.888)	1.510 (2.189)
Log likelihood	-28.745	-27.870	-28.718
Number of obs.	93	93	93

Note: standard errors in parenthesis; constant estimates baseline odds

Table 2.3: Odds ratio of woman having missed a prenatal appointment in the previous 6 months

"Missed a prenatal appointment in the past 6 months"	(1)	(2)	(3)
	<i>Odds ratio</i>	<i>Odds ratio</i>	<i>Odds ratio</i>
<i>Treatment group (1=yes)</i>	1.530 (.804)	1.748 (.980)	.901 (.384)
<i>Has any formal education (1=yes)</i>		2.442 (3.260)	.989 (.849)
<i>Household earned, on average, 7,000-15,000 HTG per month in the previous 6 months (1=yes)</i>			.612 (.280)
<i>Household earned, on average, >15,000 HTG per month in the previous 6 months (1=yes)</i>			.545 (.335)
<i>Respondent earned any individual income during the previous 6 months (1=yes)</i>		.868 (.445)	
<i>Household had continuous access to functional public transport in previous 6 months (1=yes)</i>	.279 (.205) .	.281 (.210) .	
<i>Respondent's reported travel time to health facility is more than 30 minutes (1=yes)</i>	.918 (.671)	.974 (.721)	
<i>Constant</i>	2.609 (2.604)	1.096 (1.896)	1.347 (1.183)
Log likelihood	-48.572	-48.321	-67.714
Number of obs.	73	73	99

Note: standard errors in parenthesis; constant estimates baseline odds

Table 2.4: Odds ratio of children having missed school in the previous 6 months

"Children missed school in the past 6 months"	(1)	(2)	(3)	(4)
	<i>Odds ratio</i>	<i>Odds ratio</i>	<i>Odds ratio</i>	<i>Odds ratio</i>
<i>Treatment group (1=yes)</i>	1.165 (.163)	1.212 (.170)	1.150 (.170)	2.102 (.505) **
<i>Number of children in household</i>	1.155 (.050) **	1.171 (.051) ***	1.156 (.053) **	1.049 (.067)
<i>Household earned, on average, less than 7,000 HTG per month in the previous 6 months (1=yes)</i>	.479 (.224)		.452 (.234)	.257 (.188) .
<i>Household earned, on average, more than 15,000 HTG per month in the previous 6 months (1=yes)</i>		.592 (.097) **		
<i>Household has no own transport (1=yes)</i>	1.496 (.214) **	1.312 (.189) .	1.260 (.194)	1.632 (.362) *
<i>Household had continuous access to functional public transport in previous 6 months (1=yes)</i>	.298 (.104) **	.418 (.102) ***	.270 (.105) **	.207 (.129) *
<i>(Household earned <7,000 HTG per month) x (Household had continuous access to functional public transport)</i>	1.796 (.878)		1.936 (1.042)	3.719 (2.849) .
<i>Reported travel time to primary school is more than 30 minutes (1=yes)</i>			2.097 (.297) ***	
<i>Reported travel time to secondary school is more than 30 minutes (1=yes)</i>				1.582 (.351) *
<i>Constant</i>	4.161 (1.519) ***	3.269 (.908) ***	3.442 (1.411) **	4.948 (3.253) *
Log likelihood	-682.724	-679.434	-610.131	-270.098
Number of obs.	1,205	1,205	1,100	509

Note: standard errors in parenthesis; constant estimates baseline odds

Table 2.5: Odds ratio of having sold any harvest in the previous 6 months

"Sold some pf the harvest in the past 6 months"	(1)
	<i>Odds ratio</i>
<i>Treatment group (1=yes)</i>	.620 (.107) **
<i>Gender (1=woman)</i>	.941 (.176)
<i>Age</i>	.997 (.006)
<i>Has any formal education (1=yes)</i>	1.098 (.210)
<i>Household has no own transport (1=yes)</i>	.772 (.199)
<i>Respondent produced either cash crops only or both cash and other crops (1=yes)</i>	1.336 (.341)
<i>Constant</i>	2.224 (1.026) .
Log likelihood	-385.291
Number of obs.	573

Note: standard errors in parenthesis; constant estimates baseline odds