

POLITECNICO DI TORINO

Corso di Laurea Magistrale

In Engineering and Management

Tesi di Laurea Magistrale

Preliminary assessment of the impact of shelter interventions
in the social dynamics of beneficiaries



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Anno Accademico 2018/2019

PRELIMINARY ASSESSMENT OF THE IMPACT
OF SHELTER INTERVENTIONS IN THE SOCIAL
DYNAMICS OF BENEFICIARIES

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Abstract

In the humanitarian domain the Shelter sector's scope includes all activities related to achieving the right to adequate housing with a humanitarian focus.

Although anecdotal evidence suggests that there is a strong link between shelter activities and the improvement of non-house related social conditions of beneficiaries, rigorous studies assessing this link are still very limited and not available in the case of Haiti. Furthermore, rigorous evidence-based guidance for the decision makers (government and international partners) on the most effective resource allocation in the shelter sector is still missing.

The following thesis was conducted during 5 months of internship in the International Organization for Migration (IOM) in Haiti. IOM is one of the principal actors in the shelter sector and is responsible for the coordination of the national Shelter Working Group.

This thesis uses two unique datasets to run a linear regression analysis with the aim of observing the effect of housing quality on schooling attendance. Being close to the field operations it was possible to collect data from the shelter partners of IOM and from government institutions building a dataset made of the best available information on the topic for the case of Haiti. An additional field data collection was created, organized and implemented to complete the datasets and to have a one year time dimension in the data collection.

The research activities have been heavily influenced by the recent political situation of Haiti but a preliminary assessment of the impact of housing on the schooling attendance was still possible. The result of the linear regression model used for the statistical analysis suggest that the housing condition of a rural family affected by a natural event in Haiti affects the schooling attendance of the children of the household.

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1 PREAMBLE

My five months internship started the 7 of July 2019 at the International Organization for Migration (IOM) of the United Nations (UN) in the country office located in Port-au-Prince, Haiti. As an intern I started working in the Shelter Unit under the supervision of the Coordinator of the Shelter Working Group being responsible for the analysis of the shelter conditions of the population affected by the earthquake occurred in the North of the country in October 2018.

The idea behind this thesis came from the actual needs that the shelter unit in IOM has in the allocation of resources. In the humanitarian sector is of great importance to support the projects with a deep understanding of the context and of the social dynamics that are going to be touched by the humanitarian investments and in the shelter sector there is a lack of research when it comes to social impact of its interventions. Therefore, this project is both a professional report that is going to be used by IOM Haiti to allocate resources on its projects and my master thesis.

The research question was posed by IOM and required a new data collection in the areas affected by the earthquake of October 2018. The interest of IOM for the topics addressed in this thesis is demonstrated by the resources that has been allocated to put in place the new data collection.

Before the next chapters in which the research will be presented, it is worth to briefly present the political situation in which this project has been conducted since it has been a major challenge for all the people involved in the research.

Haiti faced almost two months of demonstrations starting from August 2019 and the country has been blocked under many perspectives. The capital Port-au-Prince has been the scene almost daily of organized and spontaneous demonstrations, usually peaceful, but which could quickly degenerate into acts of violence and destruction. Getting out of the house was not easy, especially for those who lived in neighbourhoods in the southern part of the city. Some schools opened on days when there were no official demonstrations, but in the terror that teachers and students were threatened, most of the schools have been closed for months. Endless queues surrounded the fuel and methane stations, unobtainable for long periods of time. Gunshots were and are still exploded every night without interruption. The main roads connecting the capital to the departments were dotted with barricades, almost always on fire,

sometimes impassable, often controlled by armed gangs that take advantage of the situation of anarchy to rob drivers and passengers of public transport, or to rob trucks carrying goods and materials. In the provinces, necessities started to be rare, too expensive for the local population. The supply of fuel has been completely suspended in the past months and is now at the mercy of the black market. During the few days in which banks have been opened, they rationed the cash that became scarce. The political situation of the country left the population without plans for the future and a solution seems to be just a far hope in a country that has been always struggling with poverty and that faced the worst natural disaster occurred in recent years.

In this context, the research activities were more difficult than expected and required a high level of planning and coordination. The data collection planned for this thesis took place with two months of delay and is still on going. The first analysis of the original plan was still possible and will be presented in the following chapters.

Personally, this thesis is not only a research paper but also a testimony of the difficulties that the Haitian population faces every day. Finally, I see this work as little step in the direction of a closer collaboration between the engineering universities and the humanitarian sector which is little considered as a career path by the young engineers coming out of the European universities. A deeper exchange could be a great benefit for the sector, that would gain a more interdisciplinary and technical approach, and for us, too often concentrated on our little problems.

2 INTRODUCTION

The overall objective of this study is to investigate the impact of shelter activities on social dimensions not directly related to housing, like access to education, health and household incomes providing a better understanding of these links. The assumption of this study is that providing reliable shelter for vulnerable households not only contributes to lowering the socioeconomic losses caused by disasters, enhancing resilience and sustainability in the housing sector and addressing risk reduction, but it also contributes with a cascade effect on multiple aspects of the current and future socio-economic condition of the families receiving shelter support. Therefore, shelter projects contribute to addressing social issues of multidimensional nature impacting vulnerable individuals.

Due to the complexity of the topic and the little standardization of the humanitarian activities, the so called shelter interventions will be considered as an economic investment that higher the housing quality of the beneficiaries.

The aim of the Shelter Working Group in Haiti is to provide safe protection against natural events, enhancing resilience of individuals and communities before and after natural disasters. In the context of Haiti, shelter activities are particularly relevant taking into consideration the country's high geographical risk to natural disasters. Haiti is ranked as the most vulnerable country to climate change and weather catastrophes in Latin American and the Caribbean, and the 14th most vulnerable country in the world. The vulnerability of the Haitian population to natural disasters is very high, due to lack of infrastructures, health facilities, safe construction standards, the limited access to temporary shelters and the increased probability of landslides due to deforestation. The risks are further increased by the socio-economic context, with the majority of the population living well below the poverty line.

In general, both the Sustainable Development Goals (SDGs) (United Nations, 2019) framework and the Humanitarian Needs Overview (HNO) highlight the importance of the shelter sector to enhance the resilience of the Haitian population to natural disasters. In particular, the shelter sector related activities directly contribute to the achievement of the following four SDGs:

Goal Description:

1. SDG 1.5 By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters
2. SDG 11.5 By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations
3. SDG 11.B By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels
4. SDG 11.C Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials

In addition to the SDG framework, the shelter sector is directly related to the needs assessed by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) in the 2019 Humanitarian Needs Overview (HNO) and its activities are a core part of the Humanitarian Response Plan (HRP). The HNO refers to the “Need to strengthen the preparation for natural disasters”. This need is addressed by the HRP in several of its objectives. For instance, the second objective of the HRP talks about the need “to bring lasting solutions to those who are not able to provide for their shelter needs. Support for self-reconstruction, Build Back Safer approach or support for construction through courses and trainings for the carpenters and masons or the use of the workers already trained will be supported by those affected by Hurricane Matthew and by earthquake of October 2018”. Finally, the UN Development Assistance Framework (UNDG United Nations Development Group, 2017), in its fourth outcome refer to the need to “strengthen sustainable management of natural resources and environment, territorial and population resilience, especially for the most vulnerable, to respond to natural disasters, to climate change and humanitarian crisis, while ensuring continued sustainable development”. All these objectives are directly linked by Shelter Working Group activities headed by the Department of Civil Protection (DPC) and by the Housing and Public Building Construction Unit (UCLBP), with technical coordination assistance of the shelter unit of IOM in which this study took place.

Thanks to the close collaboration with the “Ministère des Travaux Publics, Transports et Communications” (MTPTC), it was possible to access the database of the structural evaluations that took place in the earthquake of 2018 affected areas. This database was the basis of the analysis and made possible to study the link between the housing condition of the population and some social indicators. The second important source of data was the database provided by the information system of the Ministry of Social Affairs and Labour (SIMAST) managed and founded by the World Food Program (WFP). The SIMAST collects demographic data and allowed to study the implications of the shelter interventions in the domains of education, health and income generation. In conclusion, IOM implemented a new data collection with the objective of providing a one year time dimension to the data collected.

The research, as originally planned, was intended to provide the following outputs:

1. A preliminary assessment of the causal effects of shelter quality on education.
2. A systematic analysis of the costs and benefits of alternative intervention options with respect to four main criteria: equity, timeliness, sustainability and resilience; with a view of offering guidance and advice to decision makers on the optimal option in each natural disaster scenario.

Due to the above mentioned political situation it was possible to collect data for the first output while for the second data is still missing and will be only briefly presented in the methodology chapter without the data supporting the analysis.

The following chapters will present several topics with the aim of contextualizing the research objectives. First, will be analysed the context of the research referring to all the analysis that have been performed during the internship period focusing on the crisis following the earthquake of 2018 that affected the north of Haiti. Second, will be presented the literature review with the aim of showing the one of the few social assessments of shelter interventions and the relationship between shelter and housing which proves the relevance of an analysis of the impact of shelter interventions on the social dynamics of beneficiaries. Third, will be presented the data collection phase with a description of the data sources. This phase was the most time consuming due to the highly bureaucratic relationships that has been put in place with the national authorities to access the datasets. Moreover, the field data collection organized for this study will be presented even if, due to the mentioned delay, was not used for the analysis. Forth, will be presented the methodology of the preliminary assessment of the impact of housing on the schooling attendance in the areas of the earthquake. Fifth, will be shown the

results of the analysis. Finally, will be provided the conclusions and some future research suggestions.

3 CONTEXT AND LITERATURE REVIEW

This section is divided into four parts, the first one will be an overview of the natural disaster exposure of Haiti. The second one will contextualize the research in the work that have been performed IOM including a general assessment of the housing needs of the population in the area of the earthquake and a cost analysis of the necessary interventions. The third one review the literature on the link between shelter interventions and social dynamics focusing on the main reference that assesses the impact of the interventions on the economic activities of households. Lastly, will be discussed the relationship between the concept of shelter and the concept of housing showing that shelter activities have an impact that goes beyond the emergency response phase The aim is to present the research in the context of the internship experience, to show the work that has been performed and to present the gaps in literature that this thesis contributes to.

3.1 HAITI NATURAL DISASTER EXPOSURE AND CONSEQUENCES

Haiti is one of the most exposed countries in the world to natural hazards that include hurricanes, floods, earthquakes, landslides, and droughts. From 1994 to 2013, Haiti was considered the third most affected country by extreme weather events in terms of lives lost and economic damages. More than 96 percent of the population is at risk of two or more hazards, and 56 percent of the country's GDP is linked to areas exposed to risk from two or more hazards. The impact can be extensive. The 2010 earthquake caused over 200,000 deaths. Damages and losses were equivalent to 120 percent of Haiti's GDP.

Urban and rural populations in coastal areas are particularly vulnerable to climate and natural hazard events. Natural hazard risks are further exacerbated by inadequate building codes and a lack of regulatory enforcement. According to the Humanitarian Response Plan 2019-2020 which is the yearly strategy to address the population needs drafted by OCHA, the terrible earthquake of January 2010 and the more moderate one of October 2018 had a profound impact on the country with after-effects still visible today, including 37,500 people still in camps for displaced people since 2010 awaiting durable solutions, and 157,000 people affected by the last

earthquake in the departments of Nord-Ouest, Nord and Artibonite for which medium-term assistance remains to be provided.

A natural disaster occurs when a natural hazard interacts with a population, causing harm to people and/or damaging property. Noy & duPont in a literature summary about the Long-Term consequences of natural disasters find that small island nations have been found to be less resilient in the long term compared to continental nations (Noy & duPont, 2016). The inequality of impacts is not only limited to comparisons between nations but is observed within nations as well. One of the ways in which this dynamics is most evident is by examining the rural-urban divide. Wealth is not spread evenly within countries, and it tends to be more heavily concentrated in and around cities. With limited resources, countries are generally faced with having to decide which areas to protect and with how many resources. Since cities have a much greater concentration of both people and property, resources tend to be allocated towards protecting cities, sometimes at the expense of the surrounding rural areas. For example, levees can be put in place to protect a city, yet the water still needs an outlet somewhere. Besides the degree of vulnerability to direct impacts, the ability of countries, regions, cities, or even households to bounce back and recover from disasters also differs. In the short term, the ability of the economy to return to grow at its previous trajectory is largely dependent on its ability to access resources for reconstruction; Klomp and Lazzaroni provide surveys of this short-run literature (Lazzaroni & Bergeijk, 2014) (Klomp & Valckx, 2014).

3.2 HUMANITARIAN RESPONSE AND SHELTER INTERVENTIONS

There are many elements of a post disaster context education, health, nutrition, WaSH (Water, Sanitation and Hygiene) and shelter. All of them need to be addressed when recovering from natural disasters and the recovery strategy for each of them is divided into two stages, relief and development. If best practices in the two domains are well established and understood, it is often the transition between the two phases that creates inefficiencies both in the allocation of funds and in the impact of the programs. The link between the two phases is called “Nexus”. The United Nations Office for the Coordination of Humanitarian Affairs (OCHA) is a United Nations body formed in December 1991 by General Assembly Resolution 46/182. The resolution was designed to strengthen the UN's response to complex emergencies and natural disasters. The main activity of the organization is to coordinate the humanitarian effort to avoid misallocation of resources. In “New way of working”, a booklet published in 2017, is highlighted the importance of addressing the humanitarian crises following a natural

disaster with a comprehensive approach that takes into account not only the short term needs but also the long term consequences and the nexus phase:

“Strengthening the humanitarian-development nexus was identified by the majority of stakeholders as a top priority at the World Humanitarian Summit (WHS), including donors, NGOs, crisis-affected States and others, and it received more commitments at the WHS than any other area. The New Way of Working (NWOW) as outlined in the Secretary-General’s Report for the WHS and the Agenda for Humanity represents an approach to put this into practice.” (United Nations, 2019)

Shelter activities in Haiti vary from provisional shelter against the elements in the short-term period after a natural disaster (relief) to permanent dwellings that facilitate the social and economic participation of the residents in society (development). This thesis takes into account the all process of recovery from a natural disaster. It is also a capital intense sector which makes decisions in the donor perspective quite challenging. Under budget constraints, the trade-off between relief and development is difficult to find and there is a lack of tools and methods to assist the decision making on this matter. This trade-off is only the first of a long series when it has to be decided how to invest funds in the shelter activities as in many other sectors. However, according to the existing literature it seems to be particularly hard in the shelter sector due to the lack of tools to guide the decisions. In donor’s perspective there are two main concerns when it comes to decision making which are budget and social impact in its broadest meaning. Ideally, knowing the precise social impact based on a series of social indicators and knowing the budget available to a shelter intervention it would be possible to plan the most efficient set of interventions accordingly to the context. This is why there is the need to better understand the relationships between the investments in the shelter sector and their social impact on the beneficiaries.

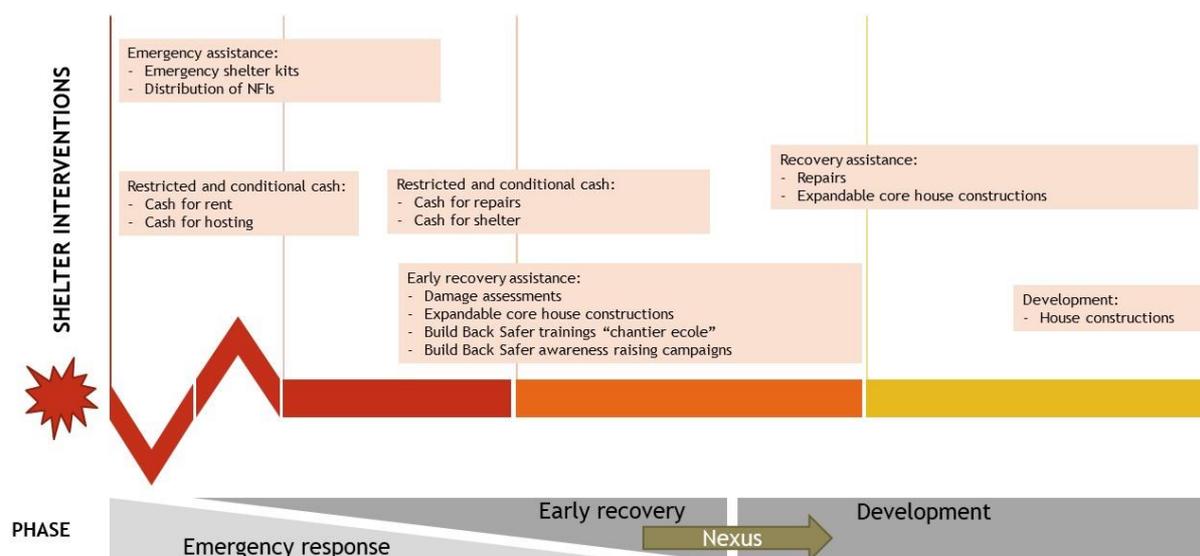


Fig. 1.1 - Shelter interventions

3.3 CONTEXT OF THE OCTOBER 2018 EARTHQUAKE

On October 6th, 2018 at 8:12 p.m., a 5.9 magnitude earthquake was recorded in Haiti, at a depth of 15.3 kilometres. According to the Technical Seismology Unit which is belonging to the Ministry of mines and energy (BME), its epicentre was located in the Turtle Channel, about 20 km Northwest of Port-de-Paix in the Northwest department.

Several aftershocks were subsequently recorded in the area. On October 7th 2018, an earthquake of magnitude 5.2, located 10 kilometres deep and 32 kilometres north-Northwest of Port-de-Paix, and another on October 8th 2018, of magnitude 4.2 located 10 kilometres deep and 16 kilometres north-Northwest of Port-de-Paix.

Overall, damages were recorded in a total of three departments: North, North-West and Artibonite.

3.3.1 HIGHLIGHTS

- The 2018 earthquake killed 18 people, eleven in the North-West department and seven in Artibonite. Across the three departments, a total of 714 wounded individuals were identified and treated in local hospitals and nearly 31,500 families were affected;

- According to a damage assessment conducted by the Directorate of Protection Civile (DPC), 261 institutional buildings were significantly damaged; 29,433 homes were damaged; and 2,600 homes were destroyed, with most of the damage being recorded in Saint-Louis du Nord, Port de Paix and Gros-Morne;
- The Civil protection department at central level (COUN), departmental level (COUD) and local level (COUC) ensured coordination for the response;
- Assistance from governmental and humanitarian actors to the affected populations have been provided in the form of mobile hospitals, assistance for funerals, NFIs and food distributions and psycho-social support;
- Observation visits and needs assessment missions were carried out to better identify the needs of the affected population.

3.3.2 SHELTER SECTOR NEEDS FOLLOWING THE EARTHQUAKE

The Ministry of public works, transportation and communications (MTPTC) in collaboration with Department of Civil Protection (DPC) and IOM assessed the structural conditions, and the households' vulnerability of over 20'000 buildings in the four main cities of the affected areas: Port de Paix, Chamsolme, Gros Morne and Saint-Louis du Nord. The assessments took place between May and August 2019. Buildings were classified using a colour coding system. Houses and buildings were marked as "red" when the structure was found to be highly damaged and declared inaccessible; "yellow" when partially damaged; "green" when the structure was found to be intact. Some of the buildings couldn't be analysed in detail either because owners were not available or because they were significantly damaged what would have made it too dangerous to enter. The analysis will be conducted considering the red and yellow marked houses which are the target of the interventions.

The following table shows the aggregated data of the shelter sector needs based on the DPC post-earthquake assessment and MTPTC evaluations.

2018 Earthquake affected areas: Nord, Nord West, Artibonite		#
Red Code Houses to rebuild	Not vulnerable families	1482
	Vulnerable families**	676
	Highly vulnerable families**	442
	Total*	2600
Yellow Code Houses to repair	Not vulnerable families	16781
	Vulnerable families**	7652
	Highly vulnerable families**	5000
	Total*	29433

*DPC Post-earthquake assessment **MTPTC-IOM protection assessment

Tab. 3.1 – Impact on houses and vulnerability

Data is based on MTPTC evaluations in Chamsolme, Gros-Morne, Port de Paix (3rd and 6th communal sections) and Saint-Louis du Nord and on the general assessment made by DPC in the rest of the affected area.

The vulnerability measure used in the table above is calculated with the following indicators: number of women, men, elderly and teenagers; the size of the family; the presence of pregnant women; people with physical, sensorial or mental disabilities; the mono-parental conditions; the number of children and orphans in domestic servitude and the presence of people with chronic diseases. The vulnerability classification is used to target those most in need and to guide the efficient allocation of funds. The vulnerability score among the participants of the survey ranges from 0 to 24. The vulnerability categories of “not vulnerable”, “vulnerable” and “highly vulnerable” are assigned according to the score as shown in the table to the right. The share of households in each category was calculated based on data collection.

Classification	Score	Share %
Not vulnerable	0-9	57%
Vulnerable	10-12	26%
Highly vulnerable	13+	17%

Tab. 3.2 – Vulnerability classification

3.3.3 THE NEEDS IN NUMBERS

The following data shows the housing conditions and the vulnerability distribution of the areas evaluated by MTPTC. The evaluation assessed the structural conditions, technical needs to repair structures and the vulnerability of the households. In the following tables the three vulnerability categories are distributed based on the score of the family, in green is shown the number of families with no vulnerability, orange identifies the vulnerable ones while red refers to the highly vulnerable families.

3.3.3.1 Chamsolme

In Chamsolme, the total number of inaccessible houses that need to be rebuilt is 236. Among those, 36 families are classified as highly vulnerable and 50 as vulnerable. The number of damaged houses that need to be repaired is 1004. Among those, there are 146 families classified as highly vulnerable and 248 as vulnerable.

Reconstruction		Chamsolme		
N*	236			
Vulnerability	87	50	36	

Repairs		Chamsolme		
N*	1004			
Vulnerability	524	248	146	

3.3.3.2 Gros-Morne

In Gros-Morne, the total number of inaccessible houses that need to be rebuilt is 1049. Among those, 163 families are classified as highly vulnerable and 199 as vulnerable. The number of damaged houses that need to be repaired is 4176. Among those, there are 656 families classified as highly vulnerable and 1045 as vulnerable.

Reconstruction		Gros-Morne		
N*	1049			
Vulnerability	396	199	163	

Repairs		Gros-Morne		
N*	4176			
Vulnerability	2090	1045	656	

3.3.3.3 Port de Paix

In Port de Paix, MTPTC conducted the evaluations in the 3rd and 6th communal sections. The rest of the evaluations will start at the beginning of December 2019. The total number of inaccessible houses that need to be rebuilt is 204. Among those, 23 families are classified as

highly vulnerable and 37 as vulnerable. The number of damaged houses that need to be repaired is 1097. Among those, there are 161 families classified as highly vulnerable and 260 as vulnerable.

Reconstruction	Port de Paix		
N*	204		
Vulnerability	93	37	23

Repairs	Port de Paix		
N*	1097		
Vulnerability	596	260	161

3.3.3.4 Saint Louis du Nord

In Saint-Louis du Nord, the total number of inaccessible houses that need to be rebuilt is 368. Among those, 66 families are classified as highly vulnerable and 48 as vulnerable. The number of damaged houses that need to be repaired is 2165. Among those, there are 407 families classified as highly vulnerable and 489 as vulnerable.

Reconstruction	Saint Louis du Nord		
N*	368		
Vulnerability	147	48	66

Repairs	Saint Louis du Nord		
N*	2195		
Vulnerability	1027	489	407

3.3.4 REPAIRS COSTS ESTIMATION

Following the October 2018 earthquake, within the structural evaluation project run by MTPTC and IOM, two type of evaluations were implemented in Gros-Morne, Chamsolme, Saint-Louis du Nord and 3rd – 6th communal sections of Port de Paix. The evaluations in the other sections of Port de Paix will start at the beginning of December.

Evaluations consisted in:

- *Rapid evaluations*: rapid structural evaluations with a vulnerability assessment mainly based on protection. The first output of these evaluations is categorization of buildings using a color-coding system. Houses and buildings are marked as “red” when the structure is found to be highly damaged; “yellow” when partially damaged; “green” when the structure is found to be intact. The second output of the evaluations is a database containing the type of structures and the vulnerability of the households.

- *Detailed evaluations* are deep structural evaluations. The outputs of these evaluations are detailed information of structural damages which allow to calculate the costs of the required interventions.

3.3.4.1 Numbers of evaluations

The calculation of the repairs costs of the houses affected by the earthquake is based on both detailed and rapid evaluations. Between May and August 2019 were collected 21'601 rapid evaluations and 1'065 detailed evaluations. The criteria used to allocate resources on the two evaluations was to maximize number of rapid evaluations in order to have the most complete picture of the situation following the earthquake. The detailed evaluations were collected until it became statistically insignificant, for the cost calculation, to collect more data.

3.3.4.2 Categorization

In order to estimate the total costs of repairs, four categories of houses are identified based on the following two criteria:

- Structure type
- Estimated damages

Those categories are chosen to represent the conditions of evaluated houses. In the following table are defined the categories:

Category	Definition
CAT1	Estimated damage between 10-30% and a “Murs porteurs ¹ ” structure typology
CAT2	Estimated damage between 10-30% and any other kind of structure typology
CAT3	Estimated damage between 30-100% and a “Murs porteurs” structure typology
CAT4	Estimated damage between 30-100% and any other kind of structure typology

In the following table are shown the total numbers for each category. It must be noted that these numbers refer to the “yellow code” houses evaluated in rapid evaluations. These are buildings that need repairs after the assessment.

Category	Share of houses - <i>Rapid evaluations</i>	#
CAT1	30%	2537
CAT2	34%	2882
CAT3	15%	1308
CAT4	21%	1745

As expected, the share of each category, therefore its distribution, is very similar if we look at the detailed evaluations demonstrating the good quality of the detailed evaluations sample:

Category	Share of houses - <i>Detailed evaluations</i>	#
CAT1	31%	183
CAT2	32%	191
CAT3	14%	82
CAT4	22%	132

3.3.4.3 Category cost calculation

Each detailed evaluation carries the Bill of Quantities drafted by the engineers that evaluated the house. These documents contain detailed assessment of the structural damages of the building. Depending on the type of damage and the “surface” to repair, quantities of necessary materials are calculated. In the following tables are shown market prices available in the commune of Gros-Morne, these are used to calculate the total costs:

¹ “Murs porteurs” structures are based on load-bearing walls in cement or reinforced concrete.

Material	GRD
Sable (m3)	510
Gravier (m3)	580
Ciment (sac)	675
Eau (gallon)	5
Ø1/4 (lb)	130
Ø1/2 (lb)	625
Fil à ligaturer (lb)	50
Trellis (m2)	250

On top of the material costs are added the following costs:

Other costs	GRD
Labour cost	40% of material costs
Transports	30% of material costs
Unforeseen events	10% of material costs

First, the cost calculation is run for each detailed evaluation. Secondly, the average cost of each category is calculated, the following table shows the results of the analysis:

Category	Repairs cost
CAT1	781 \$
CAT2	567 \$
CAT3	1194 \$
CAT4	860 \$

As expected, price grows with damage intensity and is higher for the “Murs porteurs” typology which, on average, carries more expensive damages.

3.3.4.4 Total cost estimation

With the categories costs it is possible to estimate the total costs for houses evaluated with the rapid evaluations multiplying the average category cost by the amount of houses belonging to the correspondent category. The following table shows the results of the analysis with an additional classification showing the fraction of costs related to the most vulnerable households according to the protection assessment made with the rapid evaluations. On top of

the cost evaluation performed for the area assessed by MTPTC (Gros-Morne, Chamsolme, Saint Luis du Nord and 3rd – 6th communal sections of Port de Paix), the table also contains the cost estimation of “All the affected area” referring to all the earthquake affected zones. This estimation is based on costs calculated above and on post-earthquake assessment made by DPC which includes the estimation of shelter damages caused by the earthquake and a multisectoral rapid assessment.

	Cost of repairs	\$
Total	All the affected area*	23’193’204
	Evaluations area (Gros-Morne, Chamsolme, Port de Paix 3rd – 6th, Saint-Luis du Nord)**	6’677’943
High vulnerability	All the affected area*	3’940’800
	Evaluations area (Gros-Morne, Chamsolme, Port de Paix 3rd – 6th, Saint-Luis du Nord)**	1’079’560
Medium vulnerability	All the affected area*	6’029’776
	Evaluations area (Gros-Morne, Chamsolme, Port de Paix 3rd – 6th, Saint-Luis du Nord)**	1’609’096

*Based on DPC Post-earthquake assessment

**Evaluations in the other sections of Port de Paix will start at the beginning of December

3.3.5 RECONSTRUCTION COSTS ESTIMATION

The following analysis gives the total costs of rebuilding the red coded houses in the earthquake affected areas. For these buildings, repairs are not possible because the severity of the damages compromised the entire structure, though the security of the family who is living inside.

The reconstruction of the houses needs to meet minimum standards set by Government of Haiti and the Shelter Working Group. First, the Sphere’s shelter standards have to be met: the minimum living space is of 3,5 m2 per person excluding cooking space, bathing area and sanitation facilities and the internal floor-to-ceiling height is at least 2.6 meters in hot climates at the highest point. Secondly, the house cost has to be below the limit set by Governmental Unit of Housing and Public Buildings Construction (UCLBP) of 222 US\$ per m2. Based on the Shelter Working Group’s partners experience, the average costs faced by the pool of

implementing partners, the price of a core-house was set at 4000 US\$ and will be used in this analysis to estimate the total costs of the necessary interventions.

In the following table are shown the costs of reconstruction for the zones of MTPTC evaluation. It is also provided an estimation for all the affected areas, calculated combining the price of a core house and the number of destroyed houses estimated by DPC in the post-earthquake assessment. Finally, it is highlighted the cost of reconstruction for the most vulnerable categories according to the protection assessment of the rapid evaluations.

Cost of reconstruction		\$
Total	All the affected area*	10'400'000
	Evaluations area (Gros-Morne, Chamsolme, Port de Paix 3rd – 6th, Saint-Luis du Nord)**	7'428'000
High vulnerability	All the affected area*	1'768'000
	Evaluations area (Gros-Morne, Chamsolme, Port de Paix 3rd – 6th, Saint-Luis du Nord)**	1'152'000
Medium vulnerability	All the affected area*	2'704'000
	Evaluations area (Gros-Morne, Chamsolme, Port de Paix 3rd – 6th, Saint-Luis du Nord)**	1'336'000

*Based on DPC Post-earthquake assessment

**Evaluations in the other sections of Port de Paix will start at the beginning of December 2019

3.4 ECONOMIC IMPACT OF SHELTER ASSISTANCE

In the existing literature is difficult to find a rigorous approach that studies the impact of shelter activities, this gap in research can be explained by the difficulties that researcher may encounter in tackling the topic.

First, while in developed countries there are systems and procedures to collect data following a natural disaster, this is not the case for the developing countries that rarely have the capabilities to implement such structures. During the research period of this study, for instance, the national statistical offices were not funded by the government due to the above mentioned political crisis which led to a lack of financial resources. Based on the experience gained in the country it is possible to say that the only reliable data easily available is coming from international organizations or from specific programs founded by international actors. This makes the data collections biased by the missions of the founding institutions which are usually driven by the ongoing crises and needs. For instance, the data collection used in this paper targets the population affected by the 2018 earthquake but has no intention to give a global perspective of the country situation due to resource constraints and. To summarize, all these dynamics limit the quality and the accessibility of country specific information which are needed in social studies. This was found to be true in Haiti since reliable demographic data was not available.

Second, the shelter interventions take place in a limited time frame after a natural disaster. Besides the timing, the natural event can occur anywhere in the world. A structured approach to study them would therefore require a strong commitment by research institutions and international organizations involved in the activities. Mobility of researchers, fast implementing data collections and a deep understanding of the national context are necessary elements rare to be found. In this sense, this thesis is unique because is the first step of a collaboration between the Politecnico di Torino and the International Organization for Migration. Tackle this challenges in an academic and rigorous way is therefore important to fill the gap in the existing literature.

Among all the possible social indicators, the economic indicators are the ones that are most addressed in this kind of researches. An important reference for the analysis of the social effects that shelter interventions have on the beneficiaries is the work done by Stephen Sheppard and Richard Hill “The economic Impact of shelter Assistance in Post-Disaster Settings” published in August 2005. They provide one of the few available studies that looks into the

impact of emergency shelter programs in the development of post-relief economies, building incomes of the affected populations and taking the first steps towards rigorous measurement of the impact of these programs on the incomes of the beneficiaries. The authors find that investments in emergency shelter provision offer significant returns, generating payback valued at three to eight times the value of the initial investment. Shepper and Hill also find that the benefits of shelter last beyond the emergency assistance period. These include positive effects on income and family health. The positive relationship between shelter investments and household's income suggest that similar link could be studied in other areas such as education, health and displacement to broaden the understanding of the impacts of the shelter sector on the other social dimensions (Sheppard & Hill, 2005).

3.5 HOUSING AND SHELTER

The shelter interventions are normally associated with a disaster context and often considered only as an emergency response. One of the assumptions behind this study is that shelter interventions are much more related to the more general concept of housing. In literature there are many studies that assess the impact of the quality of housing on inhabitants' social dynamics and this paragraph aims at showing that this literature can be relevant also in the context of shelter interventions after a natural disaster.

As discussed previously, literature on the topic of the impact of shelter interventions on some social indicators is very limited. This is not the case for literature in the field of the general impact of the housing condition of a family. Most of the studies addressing the topic of housing and its impact are based in a developed context but as but as long as literature on this matter in developing countries is not available it is worth to provide an overview of the problems that housing condition might foster in developed countries. This approach is validated by the findings of one of the first references for the sector drafted by the Office of the United Nations Disaster Relief Coordinator (UNDRO) which states:

“The most significant finding of this study is that the emergency shelter problem in developing countries is fundamentally different from that in industrialized societies, for in the third world the question of emergency shelter cannot be dissociated from the prevailing housing problem as a whole.”²

² “Shelter after Disaster: Guidelines for assistance” published by UNDRO in 1982.

This suggests that the shelter interventions can not be dissociated from a housing perspective which has much more implications than the simple concept of shelter. The same study finds that in the emergency response phase of a disaster there is an other dynamic in the psychological approach of the population which proves that also the population has an idea of the shelter projects that is much closer to the concept of housing than the concept of shelter. The UNDRO finds that in a post disaster context there is evidence of rising expectations for permanent housing among the population. To interpret correctly the phenomena is important to have in mind that the standards of housing of a third world country can be much lower than any humanitarian shelter project implemented. The international shelter projects following a disaster are usually compliant with some minimum humanitarian standard, in the case of IOM in Haiti are used the SPHERE standards³ which set all the criteria that have to be met in order to have a safe and dignified space. In the case of Haiti, besides the shelter crises caused by natural events, the minimum conditions previously mentioned are largely not met making the after disaster programs a true hope of housing improvement for the population rather than a simple shelter assistance as it would be perceived in developed countries.

Under this perspective it is possible to briefly list the impacts of housing on the social dimensions that were found in literature, even if they refer to developed countries. A commonly mentioned indicator related to low quality housing is health. According to Braveman, poor housing rises the exposure to allergens associated with poor health and higher mortality among the elderly due to the higher exposure to temperature changes. These are just examples of the many health problems related to housing. Another often mentioned effect is related to overcrowding. An overcrowded housing condition is linked both “with physical illness, such as tuberculosis and respiratory infections, and with psychological distress among both adults and children.” (Braveman P, 2011). Also Harker, in a study on the housing conditions in England and their impact on childhood, stresses the relationship between overcrowded homes and health issues such as increased probabilities of contracting deafness, blindness, behavioural problems and tuberculosis. There is also evidence that for many children the unfit condition can translate in respiratory problems and slow growth. Finally, all these issues are related to the school performances and attendance of children (Harker, 2006).

The first challenge of this paper and its subsequent research question is to assess the social impact of the shelter interventions on a series of social dimensions. While qualitatively

³https://www.ifrc.org/PageFiles/95884/D.01.02.a.%20SPHERE%20Chap.%204%20shelter%20and%20NFIs_%20English.pdf

it is well understood the need and the effect of shelter interventions on a population affected by a natural disaster, there is no quantitative evidence on this matter.

Before illustrating the data and the methodology used to answer this question, it is important to define one more time the concept of shelter interventions that is going to be used through the exposition. Shelter interventions are defined as the major interventions that are provided in Haiti by the shelter actors that work under the coordination of the Shelter Working Group. Reconstruction and repair interventions were already presented in the previous chapter, Cash for Rent is when money is given directly to the beneficiaries. It provides people with the dignity of choice, and is often significantly more cost-efficient than the delivery of in-kind aid. In programs with a shelter focus, cash may be given to project participants to access rental homes; to buy shelter materials; or to pay for labor, technical advice, or other services (CRS Catholic Relief Services, 2019). The last intervention is Formation, during the reconstructions and the repairs IOM organizes a “*chantier ecole*” which is a training session to train the local workers on the Build Back Safer (BBS) practices. Formation activities includes also specific trainings on disaster preparedness and construction techniques.

4 DATA COLLECTION

In this chapter is presented the data collection phase of the research. First, the structural evaluations performed by IOM and MTPTC are described. Second, is presented the SIMAST database. Third, the field data collection phase is presented, the data collected in this phase are not used in the analysis due to the late implementation of the data collection following the political crisis in Haiti.

4.1 IOM STRUCTURAL EVALUATIONS

With the objective of providing a first tool to assist in the shelter's resource allocations following a natural disaster, this paper is based on a structural evaluation project in the north of Haiti following the earthquake of October 2018. According to the Civil Protection Unit (DPC) report, 17 people were killed and 427 were wounded across the North West, North and Artibonite Departments. The earthquake caused significant damage to infrastructure and the DPC reported that 261 institutional buildings and 29,433 homes were damaged, and that 2668 homes were destroyed, with most of the damage being recorded in Saint Louis du Nord, Port de Paix, Gros Morne and Chamsolme. The evaluations addressed the overall level of shelter needs of the areas affected by the 2018 earthquake. Even though MTPTC conducted an assessment on a select number of buildings in the days following the earthquake, no proper large-scale evaluation of the affected structures was conducted before. Currently, there is no available data to inform shelter interventions in the affected areas. With the help of a team of trained engineers and through the structural assessments, IOM and MPTPC were able to determine the level of damage to affected houses and buildings using a colour coding system. Houses and buildings are marked as "red" when the structure is found to be highly damaged; "yellow" when partially damaged; "green" when the structure is found to be intact.

Along the duration of this project were evaluated the shelter conditions of more than 20'000 households in order to understand their shelter needs and to be able to provide the most accurate help through rebuilding, renovating, cash for rent and formation activities. The evaluations took place in the context of the earthquake of 2018 affected areas.

4.2 SIMAST DATA

SIMAST database helps to identify the most vulnerable segments of the Haitian population, analyse socio-economic trends and manage social benefits, in order to meet their economic and social needs in a more targeted way, with appropriate policies; and to increase the effectiveness of financial partners' assistance in reducing poverty. Thanks to the leadership of the Ministry of Social Affairs and Labour, SIMAST currently contains data on 270,765 households in the departments of Southeast, Northwest, Artibonite, West, Central and Grand Anse and is regularly updated and enlarged with the objective of covering all the national surface with updated data.

The SIMAST database was made accessible thanks to the partnership with the MAST, the Ministry of Social Affairs and Labour which agreed in partnering with IOM to run the research presented in this paper. The social indicators collected with systematic surveys with the help of the WFP (World Food Program) include: demographic composition of the household, presence of children under 5 years of age, presence of a permanently disabled or injured person, chronic illness at home, illiteracy, lack of basic education, absence from school, delay in school, inactivity, unemployment, child labour, hunger, lack of food, limited food consumption, absence of cash transfers, old materials for floors, roofs and walls, stacking, denial of access to lighting, deprivation in access to water, deprivation under sanitary conditions.

4.2.1 DATASET DESCRIPTION

The dataset used for the analysis was provided by the Data Management Unit of the WFP in Haiti. The data was divided into two sub datasets, the first one listing the families and the second one listing the household's members. The first database was used to cross check the data with the structural evaluations, the assumption was that each family would correspond to one evaluated house. This assumption has been proven to be not completely true due to the structure of the rural families that are not always perfectly defined. In the rural area, the settlements are surrounded by fields and are usually composed of little clusters of 2-3 houses in which often there is more than one family. Moreover, the living spaces within the houses are not defined, more commonly all the inside spaces are shared between the members of the little "community". The impact of this error for the analysis was considered to be negligible due to the interrelationships between the communities in their social dynamics.

The second dataset listing the households members was used to gather the data on school attendance used for the analysis establishing the relationship with the housing condition as described above.

The data collection of the SIMAST is performed in different periods of the year depending on the available resources to run the surveys. In the territory affected by the October 2018 earthquake there are available data for several municipalities.

The timing of the collected data is shown in the following table:

Municipality	Collected
Gros-Morne	Apr 2019
Chansolme	Dec 2018
Gonaives	Dec 2015
Bassin Bleu	Nov 2018

4.3 FIELD DATA COLLECTION

In order to run a causal analysis of the impact of the earthquake on the social indicators, a new data collection was needed to assess the change in time of the indicators. In November 2018 the SIMAST ran the questionnaire presented in the previous paragraph in Bassin Bleu and Chansolme. Since MTPTC performed the structural evaluations in Chansolme during the spring of 2019 it was possible to cross-reference data to correlate the housing condition with the social indicators collected by the SIMAST. The new data collection organized in October 2019 allowed to collect the same indicators one year after the earthquake allowing to assess the impact of the housing conditions of the population on the social indicators of interest.

The target of the new data collection were the households in Chansolme that were found on both the SIMAST data base and the MTPTC structural evaluations database. The respondents were chosen cross-referencing the two databases. The identification that has been used is the name of the members of the households. In the SIMAST database, for each household are indicated the household members. Their names were used to find database the housing conditions of the family in the structural evaluations database. This cross check could have been done with 3 identifiers: the ID number, the names, and the telephone numbers. After a

consultation with the community mobilizer, who is the local expert that implement the data collection activities, it was decided to use the names. The telephone numbers are often, in these communities, shared by many families therefore were not possible to use to compare the two databases. The ID number is often not available because the penetration of the institutions and of public services in these rural areas is still very limited. For these reasons, the names were used even if it is acknowledged a level of homonymy which lowers the quality of the cross-check. As a result of the cross reference were found 131 households on both the databases. The following image shows the distribution of the respondents on the territory around the commune of Chamsolme.

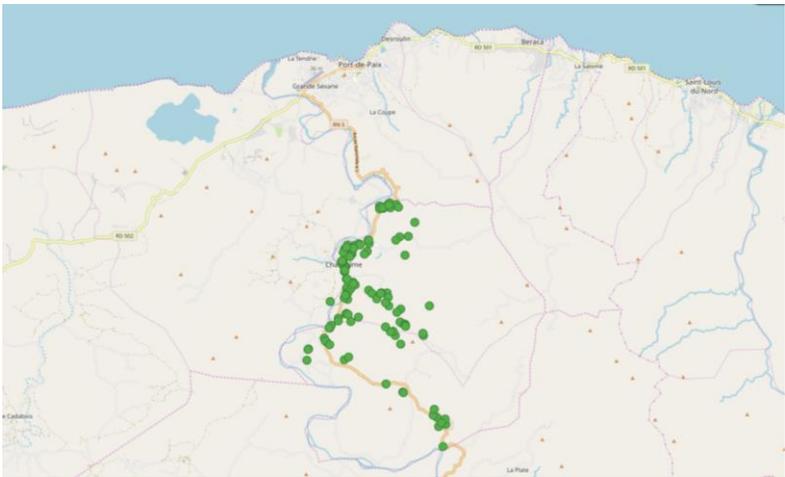


Fig. 4 - Area of the field data collection

5 METHOD

The objective of this study is to provide the following outputs: a preliminary assessment of the causal effects of shelter quality on a set of vulnerability dimensions (health, education, income) and a systematic analysis of the costs and benefits of alternative intervention options with respect to four main criteria: equity, timeliness, sustainability and resilience; with a view of offering guidance and advice to decision makers on the optimal option in each natural disaster scenario.

In the next two paragraphs are going to be described the two research questions and the methodology used to address them. In the following chapter are going to be described the results of the subsequent analysis that addressed only the first output due to the constraints described in the first chapter.

5.1 IMPACT OF HOUSING ON SCHOOLING

The first research question is: What is the social impact of shelter interventions in the short, medium and long term? The main challenge of this question is that shelter interventions are carried following a natural disaster and in such a setting there are few data collections aimed at assessing the the social impact on the long run. To measure the social effect of a shelter intervention it would be needed to collect data before and after the intervention and having a randomized controlled group which would not benefit the intervention. The challenges to run a study of this kind are quite difficult to solve beginning with the presence of a natural disaster.

However, the data collected were used to build a first assessment of the impact of the earthquake of 2018 in the field of education. The method is not replicable outside the context of Haiti and of the earthquake of last year but provided a first quantitative proof of the social impact of housing on schooling in an emergency context in Haiti.

The statistical analysis was based on the merged database in which were present both the housing conditions of the households contained in the database of the structural evaluations and the schooling indicator contained in the SIMAST database.

In order to perform the simple regression were created four variables:

- `attended_school`: defines if the kid attended school in the last 12 months.
- `rural`: defines the environment of the household and can assume the values rural or urban.
- `working_cdm`: defines if the principal member of the family of the kid is employed.
- `sick`: defines the presence of chronic diseases within the household members.
- `house_status`: defines the housing quality of the household. The categorization is made of three levels according to IOM evaluations, as previously described.

In the following paragraphs is provided a description of each variable with the interpretation of their effect on the attendance to school.

5.1.1 *ATTENDED_SCHOOL*

In the regression model used for the analysis, the `attended_school` variable is the dependent variable. This indicator is based on the question of the SIMAST questionnaire performed 2 months after the earthquake of 2018. The question on which is based this variable

is: “*La personne est allé a l'école au cours de le 12 derniers mois?*”. Since the question was asked 2 months after the earthquake but refers to the 12 months before it could be argued that is not consistent for the analysis. After careful considerations and it was assumed that it would have been a good proxy of the schooling condition after the earthquake for two reasons. First, the SIMAST questionnaire was not designed for emergency contexts and usually is not associated with an emergency response but the population is generally not informed about the international and national organizations. At the same time, the population in Haiti is famous to be used to surveys associated with natural disasters due to the unlucky history of the country, it is therefore quite likely that the responses were given thinking about the effects that the earthquake had in the 2 months before the survey. Second, the earthquake struck in October and the survey was conducted in December. Since the schools start in September after 3 months of break, it is again quite likely that the responded took the last months as a reference to say if the kids went to school or not.

5.1.2 RURAL

A key distinction of the social dynamics of the population in developing countries is the rural urban divide. In studying the long-term impact of natural disasters Noy and duPont find that the inequalities of impacts are not limited to comparisons between nations but are observed within nations as well. One of the ways this is most evident is by examining the rural-urban divide. They also find out that, according to the available literature, wealth is not spread evenly and tend to be concentrated in and around cities. On one hand this makes the economic impact of natural disasters more severe in the urban context, on the other hand makes rural populations less resilient to the shock following the crisis (Noy & duPont, 2016).

Therefore, this variable can be used as a proxy of economic wealth and is included in our analysis to take into consideration the higher frequency to school that kids of wealthier families normally experience.

5.1.3 WORKING_CDM

This variable is also a proxy of the wealth of the family. It defines the economic activity of the principal member of the households. Even if the family is in an urban context, the school attendance can be highly dependent on the employment patterns of the household. Since school

is an important expense, the decision about school attendance are naturally related to the principal economic activity.

5.1.4 SICK

An other variable that can affect the schooling condition of the children of a family is the health situation of the family members. The variable express the presence of chronic diseases within the members of the family which can be a key factor in the frequency to school of the children. Having sick family members might prevent children from going to school to take care of the primary needs of the family.

5.1.5 HOUSE STATUS

This variable is based on the structural evaluations performed by IOM. In the previous chapters was already explained the rationale behind the categorization of the homes. This variable is the key indicator of our analysis and is used as explanatory variable. According to the hypothesis of this thesis, the housing quality of the family should have an impact on the frequency with which children go to school.

5.2 SHELTER INTERVENTIONS' IMPACT MAXIMIZATION

The second output of the research, as originally planned, had the objective of responding to the informative needs of the donors. Building on the first estimation of the effect of the housing conditions on the social indicators discussed in the previous chapters it was possible to assess the positive effect of the shelter interventions with a structured approach.

The first step is to understand the effect that shelter interventions have on housing quality and the expected recovery of a household facing the aftermath of a natural disaster. This would have take into account the timing of the intervention after a natural disaster, the expected resilience of the reparation or reconstruction to future disruptive events, the available budget, the intensity of the natural event and likelihood of household recovery.

The second step was to build a model to combine those indicators giving as an output the maximum positive impact. The model was meant to provide an estimation of the best allocation of resources on the 4 possibilities of shelter interventions.

It is well acknowledged that building a model that has the ambition of providing the right allocation of funds to maximise the social outcome is a major challenge that could suffer of omitted variable bias. In order to lower the risk of omitting important variables were collected the opinions of field experts from multiple national and international agencies. This study was not performed in the ivory tower but close to the field and in the middle of the flows of information. International organizations often have a huge amount of data unexploited due to the other priorities they have to face, often in emergency. This research is the attempt to transform part of those data into useful information, an extra tool for decision makers on how to allocate the resources, based on statistical evaluations and field experience.

This part of the research was not addressed in the following analysis but was mentioned here because it is the ultimate objective and rationale of this study which will be continued in the following months in IOM Haiti.

6 RESULTS

In this chapter is going to be presented the statistical result of the linear regression performed. As this research's central research question contains the question of how the independent variables affect the dependent variable, a standard linear regression analyses was conducted on the data in STATA. The linear regression analyses attempts to find out whether independent variables are able to predict the dependent variable, in this case school attendance of the children of the targeted families.

A total of 7662 families were included in the sample, being respondents of both the SIMAST and the structural evaluations surveys. In the following table is presented the result of the linear regression performed. In the creation of the variable `house_status` was assigned a value of 1 to the families related to “red” shelters which are either destroyed or not accessible and a value of two to the “yellow” shelters which are in need of repairs. As shown in the table, the coefficients that explains the relationship between the attendance to school and the house status are different for “red” and “yellow” shelters. As expected, the coefficients seems to affect negatively the attendance to school and the children living in “red” shelters tend to have a lower attendance to school than those living in “yellow” shelters. The p-value of the variables inserted in the model indicates strong evidence against the null hypothesis making it possible to reject

it. The only variable that seems to not fit the model is the `working_cdm`, related to the employment condition of the principal of the household.

<code>attended_s~1</code>	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
<code>rural</code>	-.0592698	.0148592	-3.99	0.000	-.0884168	-.0301227
<code>working_cdm</code>	.0094825	.0172489	0.55	0.583	-.024352	.043317
<code>sick</code>	-.0716414	.0180104	-3.98	0.000	-.1069696	-.0363133
<code>house_status</code>						
1	-.0449367	.0222401	-2.02	0.044	-.0885616	-.0013118
2	-.0416198	.0129623	-3.21	0.001	-.067046	-.0161936
<code>_cons</code>	.511117	.019792	25.82	0.000	.4722941	.5499399

Tab. 6.1 – Results of the linear regression

The results show that the housing conditions have an impact on the school attendance validating the hypothesis that housing quality, in a post earthquake context, have relevant impact on the social dynamics of the population. The other two statistically significant variables, `rural` and `sick`, fit with the hypothesis on the impact that this variables might have on the school attendance of the children.

7 CONCLUSIONS

The shelter assistance is widely spread and the interventions performed every time there is a natural disaster around the world. Even so, the quantitative evidence of the impact of the shelter interventions on the social dynamics of their beneficiaries remains limited. In the humanitarian sector, not having an economical result at the end of the year that can judge the allocation of resources, it is of major importance to find other ways to take the decisions. This thesis is unique in the sense that comes from the field experience in one of the most natural disaster affected countries in the world, benefited from the governmental relationships of the United Nations to collect the data from local institutions and is one of the few attempts to study the social outcome of the investments in the shelter sector.

Even if the data collection process and the following analysis were performed successfully, there are still some limitations that have to be presented. First, the linear regression model was

built trying to find a first correlation between the housing quality of the population following the earthquake of 2018 and the attendance to school of the children of the household. Variables on the economic condition, context and health situation of the family were included but due to the complexity of the links that housing have with the life of the inhabitants there is still a considerable risk of omitted variable bias. This risk could be mitigated with a deeper understanding of the actual activities of the households and the new data collection, that was not used in the analysis due to time constraints, collected data trying to explain these relationships. It is worth mentioning that a further research effort is already planned for the following months within IOM Haiti. In order to meet the objectives first set with this research it would be needed a further research effort in the following fields:

- Experiments on building resistance in order to provide accurate measures of the expected damages following a natural events with a certain intensity. This would allow to link the disaster intensity with the housing quality measure having an output from the shelter impact maximization model in a short amount of time when a disaster occurs.
- Periodicity of the natural event. The time of the year in which a natural disaster occurs could be an important element of the disaster response. It is well understood, for example, the “back to school” effect in the context of a disaster. A model that wants to take into account the timeliness of shelter interventions should take into account the period of the year in order to decide, for instance, how to allocate the funds between public buildings and private houses.
- The parametrization of how the resilience of a housing structure improves depending on the kind of intervention that is carried, reconstruction vs reparation. This measure would allow to better shape the model taking into account the trade off between future costs due to minor resilience and present budget constraints.
- An other measure that would be important to take into consideration when running the model would be the geographical location in which interventions are carried. In particular, it would be interesting to add the historical trends of natural disasters in the location to relate them with the expected resilience and potential future costs.

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