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Resilient and Sustainable Infrastructure Systems: a Comparative Analysis of Post-Disaster Shelter Coordination, Stakeholder Participation, and Training

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Abstract

Opdyke, Aaron (PhD, Civil, Environmental, and Architectural Engineering)

Resilient and Sustainable Infrastructure Systems: A Comparative Analysis of Post-Disaster Shelter Coordination, Stakeholder Participation, and Training

Dissertation directed by Associate Professor Amy Javernick-Will

Sustainable infrastructure that is used and maintained by communities over time, and resilient to hazards, is sorely needed in developing countries where natural disasters cause disproportionate damages and mortality as well as impede development efforts. Shelter is universally recognized as a foundational element of disaster recovery; and while its ability to provide protection from the elements is a core function, it also affords broader social and economic benefits. Unfortunately, conventional approaches in post-disaster shelter reconstruction focus primarily on rapid and recognizable results over long-term outcomes, perpetuating pre-existing vulnerabilities and failing to provide acceptable standards of service. There exists a need to better understand how shelter recovery processes employed by stakeholders lead to eventual infrastructure system outcomes. This research longitudinally analyzed 19 humanitarian shelter projects following Typhoon Haiyan (Yolanda) in the Philippines over a three-year period, seeking to answer the overarching research question of *what combinations of coordination, stakeholder participation and training across project delivery phases lead to resilient and sustainable community infrastructure systems?* A multi-method approach consisting of case study methods and fuzzy set qualitative comparative analysis (fsQCA) was employed to analyze the impact of combinations of project processes in leading to infrastructure outcomes. This research (1) identified key factors influencing inter-organizational coordination in post-disaster contexts; (2) identified types of household participation that arise in shelter projects and analyzed their impact on project outcomes; (3) identified methods of construction training used in shelter projects and their impact on household knowledge acquisition; and (4) analyzed combinations of coordination, participation, and training across the planning, design, and construction phases of shelter projects that led to infrastructure resilience and sustainability, in isolation and combination. The results contribute to understanding of shelter processes and organizing structures necessary for resilient and sustainable systems, building theory of reconstruction process pathways. Practically, findings can aid practitioners identify more effective modalities of delivering shelter assistance in post-disaster humanitarian response.

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CHAPTER 1 INTRODUCTION

From 2006 to 2016, over four thousand natural disasters impacted communities around the globe. On average, this equates to more than one disaster event per day. These events killed nearly one million people, left over 21 million people homeless, and caused nearly US$6.3 trillion in damage worldwide (Guha-Sapir et al. 2017). The number of disasters and their impact on social and infrastructure systems has increased steadily, affecting more than 75% of the world's population since 1980, and caused staggering economic and human development setbacks (UNDP 2004). Figure 1-1 shows worldwide disaster data, broken down by region and global cost. The regional statistics highlight that the largest number of disasters are occurring in Asia, the Americas, and Africa – many of these nations impacted are emerging economies. Further, the number of high financial impact years has increased dramatically in the last two decades, compounded by growing urbanization and climate change.

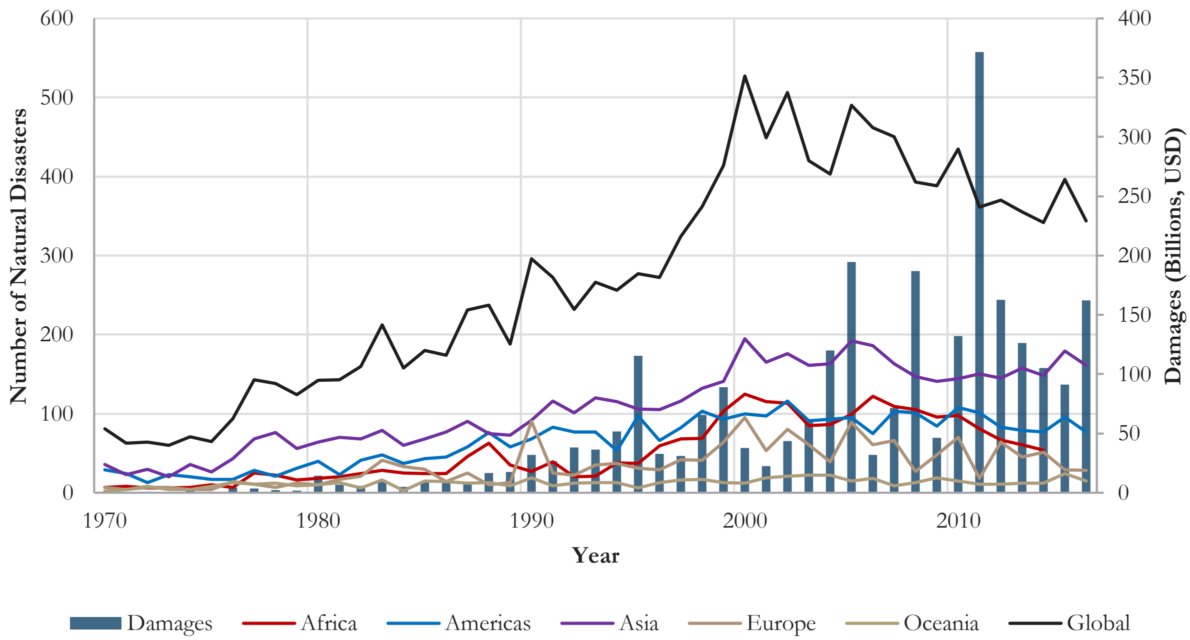

Figure 1-1: Disaster Trends[1]

[1] Data source: (Guha-Sapir et al. 2017); damages were adjusted to account for inflation using World Bank GDP deflator with 2010 as the base year (World Bank 2017)

In developing communities, where resilient infrastructure is often sorely needed, damages are up to twenty times higher than developed countries when considered in relation to national gross domestic product (GDP) (World Bank 2006). Due to the increase in number of disasters and number of people financially or socially impacted, there is increasing recognition of the need for resilient and sustainable infrastructure systems – systems that not only have the capacity to adapt when future disruptions and shocks occur but are also used and maintained over time. In the context of this dissertation, resilience is defined as the capacities that support infrastructure resistance and adaptation to natural hazards and sustainability refers to capacities that promote maintenance and longevity of functionality. To illustrate the difference between the two outcomes, a building may be structurally sound and constructed in such a manner that service can be restored quickly after a disaster, but long term financing or locally available building materials may inhibit the ability to maintain the building, leading to declining functionality over time. This research challenges conventional approaches that focus primarily on rapid and recognizable post-disaster reconstruction (e.g. number of shelters completed within a year) to one that develops *processes* that enable long-term resilient and sustainable infrastructure systems.

Early literature characterized the process of disaster recovery as defined, sequential stages; literature has since evolved to acknowledge that rebuilding is a complex, dynamic process that does not occur equally across a population (Smith and Wenger 2006). Thus, there has been a transition from a simple return to normalcy into the acknowledged need to 'build back better.' The push to respond and build communities 'back better' is confounded in the post-disaster context by severe time constraints and limited funds from a diverse group of agencies and organizations. Communities must mobilize resources and knowledge with government agencies and organizations to reconstruct damaged infrastructure that not only is able to withstand future hazards, but also provides sustainable service. The inherently complex post-disaster environment places stress on social and organizational networks, economic systems and infrastructure systems, resulting in the application of vastly different construction procedures to meet the demands of accelerated schedules and limited resources.

The absence of coordination can result in deficient, unused infrastructure and inefficient use of relief and recovery funds (Arlikatti and Andrew 2012; Ritchie and Tierney 2011). Conversely, efficient coordination can aid in efficient use of labor, money, and time, allowing for improved long-term development in communities. There is also substantial research to suggest that participation of communities is vital to instill ownership and produce infrastructure that aligns with priorities and needs (Davis 2015; Marks and Davis 2012). During the construction phase of projects, there is further a need to ensure that stakeholders have sufficient skills to implement planned infrastructure, necessitating training to transfer new knowledge (Jordan et al. 2015). The orchestration of these elements must occur in a coherent manner in order to deliver on their theorized benefits. This dissertation seeks to improve post-disaster reconstruction through addressing the following overarching question:

What combinations of coordination, stakeholder participation and training across project delivery phases lead to resilient and sustainable community infrastructure systems?

Towards this goal, I will outline rationale for selecting these aspects of recovery, present gaps in current literature, and provide detailed methods that systematically seek to answer this question and address corresponding gaps. The following passage from United States Agency for International Development's (USAID) Construction Assessment Report presents evidence to support the proposed elements of recovery and their position within infrastructure delivery phases:

> "Although emergencies create an atmosphere of urgency that surrounds USAID's response, the creation of infrastructure requires fundamental steps that are as necessary in post-emergency situations as in non-emergency situations. Fundamentally, all infrastructure projects must go through **Planning, Design, Construction**, and Operations & Maintenance. **Stakeholder involvement** and tendering/procurement can require significant amounts of time that are misaligned with the sense of urgency following a major emergency. Attention must be paid to **sustaining the infrastructure over**

> **time** through appropriate **institutional arrangements**, **trained staff**, and financial resources. To produce sound infrastructure that contributes to development objectives, the time requirement is unavoidable." – USAID Construction Assessment Report 2014 (*USAID Construction Assessment* 2014 p. 24) [emphasis added]

Rationale and Research Questions

Resilient and sustainable infrastructure outcomes are selected because of their importance for both theory and practice, answering recent calls distinguish these constructs (Bocchini et al. 2013; Rodriguez-Nikl 2015). Many of the short-comings in implementing resilience in practice stem from its operationalization and accumulation of decades of previous disaster research on sustainability without critically examining the link between these two constructs. By examining these constructs, individually, and in combination, there is potential fill a growing need to connect previous literature that focuses on sustainability with emerging findings on resilience.

This research builds on recent studies in hazard research, focusing on three critical recovery processes – inter-organizational coordination (Drabek 2007; Ritchie and Tierney 2011), stakeholder participation (Davidson et al. 2007; Lizarralde et al. 2009) and training (Ginige and Amaratunga 2011; Jordan et al. 2016). These are selected because of the growing body of knowledge that suggests the influence of each on resilience and sustainability at the community level. Coordination, participation, and training are inherently woven into the fabric of reconstruction operations. Past research has found that coordination is important to effectively allocate resources; however there are gaps in documenting *how* coordination evolves (Jahre and Jensen 2010). Further, management literature has pointed to fundamental differences between coordination structure (e.g. authority and hierarchies) (Malone 1987) and coordinating processes (e.g. dialogue and decision steps) (Faraj and Xiao 2006). There is a need to theorize on the duality of structure and process as they relate to the creation of coordination boundaries – an area that continues to plague recovery efforts.

Literature has also recently challenged the impact of participation on recovery outcomes (Lizarralde and Massyn 2008), expanding theoretical implications and deconstructing how it manifests. Frameworks of participation (e.g. Arnstein 1969; Choguill 1996) focus largely on intensity of participation, rather than the tasks that constitute participation. Existing work has yet to explain how processes of participation in planning, design, and construction differ in recovery and how this participation impacts project outcomes (Davidson et al. 2007).

Lastly, post-disaster training literature is still in its infancy. Past studies show that training increases adoption of better building practice (Lizarralde and Root 2008) and it is understood that there is a positive correlation between training and increased capacity at the community level, but the means through which this occurs is not well understood. Specifically, we do not fully understand the types of training methods that organizations are using in post-disaster contexts and which combinations of methods lead to greater retention of knowledge. A summary of the identified needs and gaps and posed sub-questions that seek to address these needs and gaps are presented below in Table 1-1.

Table 1-1: Research Gaps and Questions

Gaps	Chapter	Research Questions
Coordination continues to be framed as a structural dilemma without attention to the social practices of organizations.	2	How do post-disaster inter-organizational communication practices influence coordination boundaries?
Inadequate knowledge of what types of participation manifest in post-disaster shelter projects and how different types of participation influence shelter project outcomes.	3	What types of household participation occur in post-disaster shelter projects? How, and when, do different types of participation affect post-disaster shelter outcomes?
Limited understanding of what methods are used to train households in post-disaster construction and how different methods impact knowledge acquisition.	4	What construction training methods are used in humanitarian shelter projects? How do training methods impact the acquisition of household construction knowledge?
Lack of consideration of complex relationships between factors that lead to sustainability and resilience in the built environment.	5	What combinations of coordination, stakeholder participation and training in different project phases lead to resilient and sustainable infrastructure systems?

Research Setting: 2013 Typhoon Haiyan

Home to more than 96 million people, the Philippines ranks as the 12th most populous country in the world (World Bank 2017). Composed of more than 7,000 islands, the country is scattered across a landmass that encompasses 299,404 square kilometers (115,601 square miles). Historically, the Philippines has been one of the most hazard prone countries in the world and ranks among the top give countries hit by natural disasters (Guha-Sapir et al. 2015). In the last ten years the country has seen an average of nearly nineteen disasters annually, causing devastating loss of life and damage (Guha-Sapir et al. 2017). In the recent United Nations World Risk Report, the Philippines ranked as the third most risk prone country, only behind Vanuatu and Tonga – a dangerous combination of high exposure and prevalent vulnerabilities (Garschagen et al. 2015).

On November 8, 2013 Super Typhoon Haiyan, locally known as Yolanda, slammed into the Visayas region of the Philippines. Making landfall in the province of Eastern Samar, the storm sustained wind speeds of 315 kilometers per hour (196 mph) with gusts up to 380 kilometers per hour (235 mph) – the strongest storm to ever make landfall and the fourth most intense recorded (Evans 2014). In its wake, the storm killed 6,201 people, injured another 28,626, and impacted more than 16 million individuals (NDRRMC 2014). Infrastructure was severely damaged in multiple sectors. Over four million people were displaced from their homes, more than 1.1 million homes were damaged or destroyed, and the economic impacts were estimated at over $12.9 billion USD (NEDA 2013). A more extensive summary of the humanitarian response to Typhoon Haiyan can be found in Appendix A.

Research Methods

In seeking to address the above research gaps and questions, 19 humanitarian shelter projects were identified at the onset of the Haiyan response in the provinces of Cebu, Leyte, and Eastern Samar. These regions were selected after careful consultation with organizations working on the ground to achieve variance in shelter project strategies, while maintaining similar socio-economic composition of selected communities where projects were located. A list of the selected cases can be found in Appendix B. All projects were tracked from early planning stages through completion. Data collection consisted of interviews, documentation, observations, and surveys from field visits spanning a 36-month period. A summary of data collected can be found below in Figure 1-2. Qualitative analysis and fuzzy-set qualitative comparative analysis (fsQCA) were the two methods selected to analyze collected data.

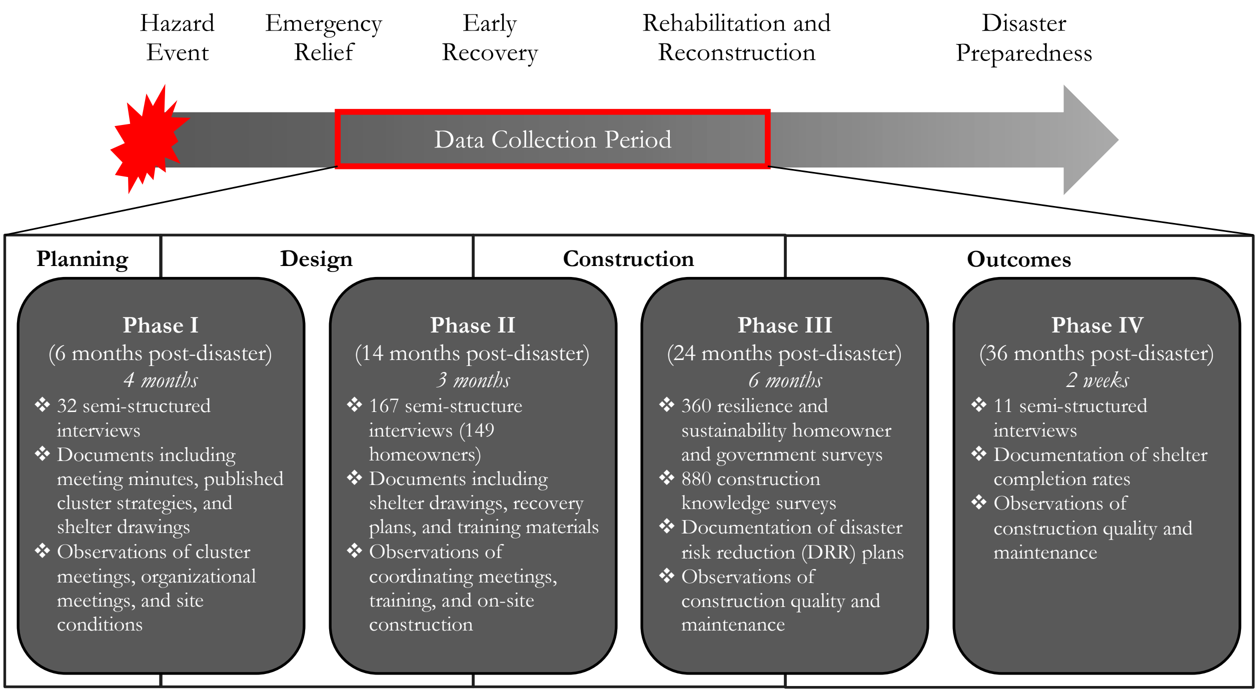

Figure 1-2: Summary of Longitudinal Data Collection

Data Collection: Interviews, Documentation, and Observations

Over the course of four separate field visits 210 semi-structured interviews were conducted with non-governmental (NGO) staff, local government officials, and community members affected by or responding to Typhoon Hiayan. For interviews conducted with households and local government officials, a local translator was used and the interview was conducted in either Waray or Bisaya. A list of the interview questions can be found in Appendix C. Participants were selected using snowball sampling techniques to identify stakeholders involved in reconstruction projects until theoretical saturation of responses was achieved. In addition to interviews, field notes were recorded from daily observation of reconstruction projects, coordination meetings, and trainings. Finally, policy documents, meeting minutes, recovery plans, and technical communication documents were also collected.

Data Collection: Surveys

Surveys were used to assess resilience and sustainability outcomes, drawing from indicators in previous literature reviews of resilience (Opdyke et al. 2017) and sustainability (Ugwu and Haupt 2007). At 24-months post-disaster, 330 households and 30 local government officials were surveyed to evaluate community level outcomes across economic, social, infrastructure, and governance dimensions for resilience and economic, social, and environmental dimensions of sustainability. Survey questions were asked verbally in the local language of the respondent, either Bisaya or Waray, and then recorded using the Qualtrics survey platform on a tablet. The questions were semi-structured, allowing for respondents to add additional details which were recorded along with observations.

Concurrent to administering a survey on resilience and sustainability outcomes, a second survey was also administered to households in the same project case communities to assess construction knowledge. The survey was administered in paper format with questions asked in the native language of the respondent. This survey was developed based on the Shelter Cluster '8 Key Messages" created in response to Haiyan. These messages provided recommended construction practice in eight areas of shelter construction that included foundations, bracing, tie-downs, joints, roofing, shape, site location, and household preparedness. In total 880 surveys were collected from across the 19 communities studied.

Qualitative Analysis

All of the chapters in this dissertation relied on qualitative analysis of interview data. This consisted of translating, transcribing, and then importing interview data into NVivo qualitative analysis software where text was then coded using inductive and deductive themes pertinent to coordination, participation, and training topics studied. A second coder was used to validate identified themes in the data using reliability measures to confirm consensus. Following coding, themes were then aggregated by project cases for cross-case analysis. A coding dictionary was used to maintain consistency in identifying themes and can be found in Appendix D.

Fuzzy-Set Qualitative Comparative Analysis

Qualitative comparative analysis lies between quantitative and qualitative methods, drawing from Boolean algebra and set theory to examine casual relationships of variables and outcomes (Ragin 1987). The method relies on first selecting outcomes of interest and then identifying variables posited to lead to these outcomes (Jordan et al. 2011). In the subsequent chapters I examined household satisfaction with shelter and safer shelter design (Chapter 3), construction knowledge (Chapter 4), and community resilience and sustainability (Chapter 5) using fsQCA. I performed analysis by identifying and calibrating coordination, participation, and training variables and project outcomes into fuzzy sets, relying on anchor points from theoretical and case knowledge to define set membership. Earlier qualitative coding and survey data was used to organize data and determine these anchor points. Coding queries were used to assist in determining set points from interview data and survey data was aggregated for each community to analyze variation in select elements of outcomes. Final set values were then compiled into truth tables that were analyzed using fsQCA software (Ragin et al. 2008). Results indicated casual pathways of conditions that lead to the presence of selected outcomes. More details on the analysis procedures of fsQCA can be found in Appendix E and Appendix F. A summary of the data and methods used for each chapter of this dissertation can be found in Table 1-2.

Table 1-2: Data and Methods Chapter Summary

Chapter	Topic	Data	Method(s)
2	Coordination	210 interviews, observations, and documents	Qualitative analysis
3	Stakeholder Participation	210 interviews, observations, and documents	fsQCA
4	Training	210 interviews, observations, documents, 880 household construction knowledge surveys	fsQCA and ANOVA
5	Resilience and Sustainability	210 interviews, observations, documents, 360 household outcome surveys	fsQCA

Dissertation Format

This dissertation is written in journal article format; each chapter is written as a standalone article in accordance with specific criteria of intended journal publications. There may be some duplication in the presentation of theory, data collection, and analysis that is required to present findings in sufficient detail. I respectfully request that citations for work published in Chapters 2 through 5 reference final journal articles published instead of this dissertation. Cross-cutting themes and findings are discussed in chapter 6, highlighting theoretical and practical contributions.

Additional supporting information on the chapters is included in appendices at the end of this dissertation. 0 provides an overview of the humanitarian response to Typhoon Haiyan in the Philippines, situating this research within shelter and housing reconstruction efforts in the aftermath of the disaster. Appendix B details the shelter project cases selected and expands on lessons learned. Appendix C includes all data collection instruments used in this research, including interview guides and surveys. Appendix D presents the coding dictionary used for qualitative analysis. Appendix E provides an overview of variable calibrations used in fsQCA across all chapters; Appendix F then expands on the analytical procedures taken in fsQCA. Appendix G includes a list of other formational publications completed during this dissertation research that complement the work included. References are compiled at the end of each chapter as well as a cumulative list at the end of the dissertation.

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CHAPTER 2 BOUNDARIES AND COORDINATION PRACTICE IN HUMANITARIAN RESPONSE

Abstract

Post-disaster contexts present one of the most challenging functional environments for organizations. The effective allocation of resources and harmonious synchronization of reconstruction activities are considered paramount factors in effective recovery. Coordination has been examined through numerous ideological lenses from scholars, however the notion of emergent practice has underscored recent trends in disaster literature. Past findings have suggested that the dynamic and adaptive structures that result from emergent coordination are more effective in handling the demands of post-disaster complexity, however there is little evidence to show how these practices develop. We examine the case of Super Typhoon Haiyan in the Philippines to demonstrate how coordination practice emerged in the planning of infrastructure systems, applying theory from emergence to explain adoption of practice that lends insight into coordinating behavior of organizations. Findings demonstrate that geography and sectors under the humanitarian clusters were most influential in shaping coordination structures while informal relationships and institutional policies were the defining factors in the emergence of communicative processes. Characterizing these organizational behaviors as they evolve in real time has yet to be documented and serves to better inform future organizational communication strategies in humanitarian contexts and theory on social movements of organizations under time-pressured environments.

Keywords: coordination, emergence, disasters

Introduction

Efforts to produce more effective coordination in disaster response have intensified over the last decade in the face of limited resources and increasing impacts from hazards; yet coordination among responding organizations still remains a challenge. The transition of recovery mantras from a ‘return to normalcy' to 'build back better' has solidified the need for coordinated strategy among humanitarian organizations (Rodríguez et al. 2007). Hazard-resistant designs that are economically viable and socially sustainable increase the complexity of program planning and have subsequently increased demands on coordination (Ingram et al. 2006). Coupled with challenges from urbanization, increasing population vulnerabilities (Thomalla et al. 2006), and globalization (Witteborn 2010), planning for the built environment in post-disaster contexts is an increasingly difficult task for governments and civil society organizations.

Organizations are required to quickly establish long-term recovery goals in partnership with NGOs, local governments, and communities early in response efforts. These strategic targets often define later recovery processes and have potential implications for disaster resilience. Understanding the means through which these objectives are established has significant potential in shaping future organizational strategy and effectiveness of recovery programs. This research seeks to address the following focal question:

RQ: What factors influence the emergence of inter-organizational structures and communicative mechanisms in post-disaster coordination practice?

This chapter seeks to examine inter-organizational coordination during the planning process of reconstruction projects following disasters. We first provide a brief background on existing literature in the field of organizational coordination theory which form the basis through which empirical case study findings are later elucidated to provide evidence of emergent coordination practice. Implications of these emergent behaviors are discussed and implications are presented for long-term reconstruction strategy.

Background

Coordination has long been deemed a necessary task among organizations who perform in complex working environments. The conceptual notion of organizational coordination has been a topic of debate among scholars with numerous points of contention arising around its lack of clarity in definition and epistemology of its nature. Initially, scholars sought to characterize coordination as an organizational state that emphasized structure (Malone 1987), modeling (Crowston 1990), and organizational design (Anderson and Warkov 1961). This view of coordination in disaster literature translated to a 'command and control' model for managing interdependencies that relied on a bureaucratic model of organizational functioning (Schneider 1992). Coordination under this theoretical stance honed on hierarchies, protocols, and authoritarian roles that divide labor within and between organizations. Standardization of procedures provides predictability to organizations, easing the inherent tensions with uncertainty associated with crisis environments (Cheng 1984). The structural stance of coordination still remains a steadfast discussion, however new avenues have opened that emphasize a process oriented understanding of coordination, differentiating coordination from the act of coordinating (Feldman and Orlikowski 2011).

In a process focused understanding, the acts of coordination become the central tenant in theory. The means through which information, resources, and knowledge are shared surface as the defining feature of coordinating (Chen et al. 2008). Theory on coordination is situated at a cross road where there is gap between previous work that relies on structuralism and newer work that demonstrates the importance of processes. While scholars have hinted at the relationships between these two, empirical instances of their linkages are few and applicability to the disaster field has not yet been demonstrated. Further, studies have largely focused on the macro or micro level of coordination, such as isolating inter and intra-organizational communication (Gittell and Weiss 2004). Linking these differing levels can provide a better understanding of individual and collective rationale and decision-making of actors. To address this gap we will focus our analysis at the organization level to hone on specific decisions, while presenting macro-level, collective behaviors that emerge from inter-organizational coordination.

Organizational Environments and Emergence Theory

Arising from the field of organization theory, institutional logic and explanations of organization behavior surfaced with Meyer and Rowan's (1977) seminal piece on rationalized myths that constitute the institutional context that surround organizations. They explained the actions taken by organizations to fulfill these myths as driven by legitimacy among peer organizations that lead to isomorphism in the institutional environment. Even from this early work, conformity to institutionalized rules is theorized as a conflict with an organization's ability to coordinate tasks, a result of decoupling formal structures from uncertainty. Institutions are formed through the diffusion of social practices (Tolbert and Zucker 1983) and, as Ansari el al. (2010) suggest, this process does not occur in a homogenous manner, rather mutations occur through the lifecycle of adoption. While we will not focus on the process of institutionalization directly in this chapter, it is important to understand as these norms are critical in governing behavior of organizations. Further, the emergence of behavior and social practice among organizations may be considered a first step towards wider, cross-national adoption.

The manner in which organizational change occurs is a complex social process influenced by a multitude of actors and pressures. Theory on emergence spans multiple fields, but the construct itself has become a study by scholars interested in the evolution of ideas, structures, and properties of systems (Goldstein 1999). The concept of emergence was born partly from the field of complexity science as a means to understand how complex systems develop order (Anderson 1999). A growing tenant of theory in the field of emergence is the importance of self-organization in systems, a practice that surfaces in disaster response. Still relatively young, the field of emergence has gained traction in disaster literature because of its ability to describe order that is created from rapidly changing response efforts. A significant, unanswered question however remains describing factors that facilitate, or hinder, the emergence process.

Cluster Coordination

Disaster coordination has seen rise to evolutionary changes over the last decade. The literature to date has largely maintained a focus and definition of coordination that is limited to emergency response activities and there is lacking knowledge of what emerges from coordination in these early stages. The earliest traces of formalized, modern humanitarian coordination come from the United Nations (UN) General Assembly resolution 46/182, dating back to December of 1991. In these early efforts to coordinate, the UN, in partnership with the national government of the affected country, was designated as the central coordinating actor. A shift was signaled in 2005 with the introduction of the humanitarian reform agenda, a vivid change coming in the form of the humanitarian cluster system. Composed of eleven sectors, the clusters are formalized bodies that are led by a pre-designated agency, such as UNICEF for the water, sanitation & hygiene (WASH) cluster. The clusters, while still highly structured, transitioned away from control towards guidance and collective action on behalf of responding organizations, paralleling the grassroots movement in development organizations (Willis 2011). Like early organizational theorists, traditional centralized structure was anticipated to lead to more effective coordination of activities, however empirical examples (Kellogg et al. 2006) provide evidence of decentralized behavior as the dominant force in organizational action. Managing authoritative roles remains a balancing act for current managers in cluster coordination. Investigation of strengths and weakness under current coordination systems is direly needed to address the increasing complexity and interdependence of programming.

Upon deployment, clusters typically remain active for short periods (less than two years), but play an influential role in rapidly disseminating knowledge and information to organizations. Efforts through the system involve program tracking that center on the '3Ws' – who, what and where. Coordination of expertise is also a central tenant that appears through direct (in-person) and indirect (published material) communication. In the context of this chapter we briefly introduce cluster coordination as much of the organizational change encountered in this research occurred through mechanisms harbored under the clusters.

Methods

Countless disasters strike each year, debilitating economies and crippling infrastructure systems, however only a select few of these events elicit an international response. While other responses must naturally employ coordinated strategy in response and recovery efforts, those disasters where there is a multi-national presence of organizations allows for examination of cases where greater social and organizational complexity manifests, accentuating the means through which coordination must occur. In this chapter, we focus on the co-created coordination space between organizations, government, and communities, selecting case study methodology to examine these communicative acts. The selection of in-depth qualitative analysis is well suited to the posed research question as it excels at investigating process oriented research (Hartley 2004), such as is the instance in complex multi-stakeholder coordination. Post-disaster contexts inherently involve rapid decision making and retrospective data collection poses challenges with participant sense making and recollection (Eisenhardt and Graebner 2007). In order to examine the coordination structures and processes employed following a post-disaster response, it was necessary to select a case where response efforts were still in their infancy so that data could be collected in real time. In examining coordinating actions, real time data was essential to capture rationale, intentions, norms, and decisions that formed the building blocks in organizational coordination strategy.

Data Collection

Among the most recent hazard events to call into action the international community, Typhoon Haiyan smashed into the central Philippines in November of 2013 with wind speeds in excess of 300 kph (185 mph). The storm, the strongest ever recorded to make landfall, devastated housing, water, transportation, education, and healthcare infrastructure. The ensuing aftermath saw cooperation between international and local partners in overseeing reconstruction. As a part of a quasi-longitudinal study of post-disaster reconstruction processes following Haiyan in the Philippines by the authors, 210 semi-structured interviews with humanitarian stakeholders were collected starting seven months' post-disaster. The gap following the disaster and start of data collection was to allow for clearing of initial emergency services that lasted for several months. Participants included local and regional governments, NGOs, cluster coordinating bodies (shelter and WASH), and local community members.

Three geographic regions – Cebu, Leyte, and Eastern Samar – were selected for inclusion based on early recommendations from government and NGO staff in order to account for differing emergent coordination practices as described by responders on the ground. It was anticipated that these differences in coordinating practice would stem partly from the local operating context but more importantly to this research, differences in normative organizational decisions and communicative mechanisms, allowing for theoretical extension of the how and why coordination practice arose. Specifically, we targeted multiple NGOs in order to ensure a diverse range of coordination approaches. In addition to interview data, field notes were recorded from daily observation of reconstruction projects, cluster coordination meetings, and internal organization meetings. Cluster policy documents, meeting minutes, organization beneficiary interview guides, recovery plans and technical communication documents were also collected.

Analysis

Following collection of data, interviews were transcribed and imported into Nvivo software for coding. In order to ensure the validity of personal accounts, interview data was triangulated with participant observation and documentation (Stake 1995). A hybrid approach to thematic analysis using inductive and deductive coding was used, deriving deductive themes from a literature review of coordination theory and inductive themes from emergent sub-topics (Fereday and Muir-Cochrane 2008). Deductive themes focused on three main topics: organizational structures, communicative processes, and goals and objectives. Structures focused on rules, hierarchies, and authority placed on actors within coordination networks. Communicative processes refer to the actions employed to transfer knowledge and information. Goals and objectives sought to examine one element of the planning process that foreshadowed intent of infrastructure reconstruction.

Qualitative coding yielded 271 references to organization structures, 620 references to communicative processes and 319 references to goals and objectives. Coding was completed independently by two researchers prior to inter-coder comparison testing to verify themes in the data (Campbell et al. 2013). Inter-rater reliability scores in the form of Cohen's Kappa coefficient were calculated within Nvivo software. Kappa coefficients, statistical measures of inter-coder reliability, represent a more robust measure over simple agreement measures as they take into consideration the amount of agreement between coders that is likely to occur by chance. Values in excess of 0.75 represent excellent agreement between coders, greater than 0.4 is generally considered acceptable and lower than 0.4 is consider poor agreement. For the three macro-themes considered, inter-coder reliability scores were as follows: 0.54 for organizational structures, 0.47 for communicative processes and 0.76 for goals and objectives. There was an overall kappa coefficient of 0.56, suggesting sufficient inter-coder agreement was achieved. Each interviews were given equal weight in averaging individual kappa coefficients. The complete set of combined coding from both coders was used for final analysis purposes. Inductive coding was conducted in multiple iterations until a defined number of codes could be agreed upon between coders. The above Kappa coefficients are the result of the final agreed upon coding structure from the authors. The primary means of analysis was using logic models (Yin 2009) to link structuring and process patterns between organizations to goals and objectives for recovery.

Key Findings

Findings from the case study analysis are presented in two sections – organizational structures and communicative processes. These sections seek to address the research question of what factors influence the emergence of inter-organizational structures and communicative mechanisms in coordination practice, supported through empirical evidence from field data. These sections are separated to bridge different bodies of knowledge on coordination, namely structural and process oriented perspectives, demonstrating the co-dependence of each in organizational behavior. A conceptual framework is then discussed in the conclusion about how this practice is influential in shaping infrastructure system planning decisions for recovery.

Organizational Structures

Geographic proximity and sector boundaries were found to be the most prominent factors in inter-organizational structures during planning that dictated how organizations chose to coordinate. The relational boundaries between organizations in disaster contexts is important because it provides a foundation for expectations of joint behavior and co-created meaning of communication. Prior to an actual hazard event, an early structure is already in place through international and local disaster response policies, NGO networks, and ongoing development and disaster response programs. Confronted with an uncertain environment, these organizational linkages rapidly change to confront the demands of a new crisis.

Emergence of Boundaries and Hierarchies from Geography

The geographic distancing of organizations from each other arose as a key element of early efforts. A comment from management of the WASH cluster highlights how crucial this was in structuring of organizations: "*I mean to me, the biggest thing in coordination in the first one month is geographic separation of people. I think if you can get that right in the first week, it is easier because you don't have people duplicating, people just spread. Make that the one theme if you are going to a meeting*." This stance was observed to be widely adopted by organizations who were eager to find communities untouched by other aid organizations. NGO staff, often veterans of several large disaster response efforts such as the 2004 Indian Ocean tsunami and 2010 Haiti earthquake, commonly referred to this organizational isolation as necessary to avoid duplication, one of the most criticized shortcomings from past responses. Following expansion from urban hubs, geography bound organizations to common challenges, political contacts, and logistical chains. This was accentuated by the large number of islands in the Philippine context, but evidence to support more widespread generalizability came from the consolidation of cluster hubs in several locations. It was not uncommon for aid workers to have to travel four to six hours during the early weeks in order to connect with other organizations working in the same region, limiting interaction and frequency of communication. Rapidly, this devolved to regional hubs of coordination under respective clusters which further broke down to coordination at the municipal government level.

Initial lead agencies under the cluster system were dictated but coordination structures shifted several months into the response when new leadership for each municipality was appointed. This shift occurred as organizations finalized locations for programming following a highly uncertain initial response period. From the onset, the clusters had been the authoritative figure in coordinating, however regulative controls set under the UN mandate started to transition this responsibility to local municipalities and a counterpart lead NGO. Selection of lead organizations was done on a voluntary basis, but the resulting structures that were generated in the aftermath of this transition were tied closely to the operational location of the lead organization. For example, one NGO volunteered to lead shelter coordination efforts for a municipality; protocols such as meeting frequency and location, reporting and inter-organizational linkages shifted to align with internal structures and location-specific practices that NGO employed. From a structural perspective of change, diffusion behaviors occurred at this critical transfer in leadership mirroring that of the lead agency. The initial separation of organizations can be seen as the spark that ignited the evolution of structures prior to contraction of boundaries and consolidation of roles.

Division of Labor through Sectors

Sector boundaries was another crucial element in the structuring of coordination, manifesting primarily under the humanitarian cluster system. These coordinating bodies improved information, resource, and knowledge exchange within their respective communities of practice, however, they often created barriers to integration of programming within organizations and resource demands for inter-organizational efforts. In interviews, NGOs focused on shelter reported that the time and resources needed to participate in multiple clusters was too demanding as time elapsed, resulting in a disconnect between the construction of shelter and WASH facilities. A NGO staff member made the following comment: "*The problem is I cannot go to follow all the clusters, it takes a lot of time and too many documents to fill. If I would follow all the clusters, I would spend 50% of my time only on this*." The result was organizations were forced to gravitate towards a single sector, whether this fit their programming or not. Boundaries became defined for many organizations though the cluster sectors where organizational language, strategy, and resources were proliferated. This effect was amplified for smaller organizations who possessed even fewer staffing resources to meet coordination demands, as observed through field observations. From these resource burdens, hierarchical structure emerged where larger organizations possessed greater decision-making power and inclusion in coordination actions. Scholars have suggested that division of labor and specialization are necessary as the complexity of tasks increase (Becker 1993). The current system may demonstrate one instance where coordination costs have exceeded the benefits of specialization and compartmentalizing tasks in the current manner are negatively impacting the ability of organizations to exchange resources and knowledge.

Communicative Processes

Informal Coordination

Literature has highlighted that coordinating appears in both formal and informal processes (Tsai 2002), suggesting that informal means lead to greater innovation and adaptability – both elements shown to be critical in dynamic decision contexts. The informal relationships, more so than formal ones, constituted a critical component in the development of how organizations overcame communication barriers and exchanged knowledge in early recovery. Formal coordination meetings, either bi-lateral or multi-lateral, were scheduled weekly or bi-weekly; however, informal communication was observed to occur daily. Not only did higher frequently occur, but staff commonly cited these informal gatherings as more beneficial to achieving meaningful dialogue. The most common instance of this was after-work gatherings of NGO staff, and occasionally government officials. Paralleling the emergent nature of informal coordination, one such site was a street food truck and bar that opened in the aftermath of the disaster. A singular site of informal coordination was encountered at each of the three regions studied. Several of the interview respondents cited that these locations allowed them to open up and share ideas without worry of being "judged" or "criticized" for critical analysis of their own and others' programs. As actors navigated the complexity associated with their respective organization's response efforts, it became clear that communicating at these informal sites was a strategy to manage the uncertainty facing organizations. It was through these assemblies that mimetic isomorphism took hold, leading to larger changes in inter-organizational behavior.

One instance encountered was the proliferation of actor mapping as a core element of program assessment. Barley and Tolbert (1997) present a sequential model for how we can examine the process of practice diffusion through four steps: (1) encode; (2) enact; (3) replicate and (4) externalize. Actor mapping is a visual aid to conceptualize relationships between stakeholders. The idea to use this mapping tool started at an informal, bi-lateral meeting between two organizations. The co-creation process led to encoding of practice between the two initial organizations, supported through informal means of communication. Enactment in implementation and eventual repetition led to diffusion to more prolific organizations which then disassociated the behavior from its initial actions, leading to adoption by other organizations. Highly structured initial communication gave way to informal means of communication which in turn reshaped inter-organizational practice. The initial actor describes the process:

> "So first it was a daily basis coordination meeting among everyone and apparently that went really well. After that when we moved, phased out of the real emergency, it was a lot less structured. So that was quite informal because I started doing that only with [NGO] early because we were just getting along quite well and then from that, [UN Agency] heard about it and asked us to replicate and to expand a little bit. So it started as personal, informal communication and then it grew up. So that was in March and we replicated the exact same for this new project so the same way all the partners involved and for this one we also involved the shelter partners who said at that time that they were including WASH as a part of their shelter project. So we sat down with [UN Agency] partners plus any other WASH partners including shelter in the coverage area. This is still a process going on since some shelter programs don't know yet if WASH is going to be part of or not. So we drew a baseline but this is a tool that will be evolving hopefully within the next two weeks to have something more concrete and structured."

Informal mechanisms also appeared to occur more frequently as bi-lateral communication and were commonly seen as more effective in the eyes of organization and government staff.

Institutional Polices

Early in recovery efforts, the Shelter Cluster adopted guidelines for the use of coconut lumber. In particular, cluster language in documents integrated and paired notions of locally available material with cultural identity, a cultural-cognitive behavior. This became the definition of an 'appropriate' shelter solution from recovery guidelines and had a significant impact on the decision process of organizations. This appearance of standardized procedures and legitimized textual sources for material selection carried significant agency that set the stage for later decisions. It appears that early adoption of coconut lumber was driven by necessity, logistics, convenience, and fulfillment of donor perceived requirements, namely use of local materials. Later decisions do not seem to reflect this same rationale and take for granted the underlying assumptions of the context where expert knowledge surfaced. In reality, many community members admitted that they had not used coconut lumber for construction prior to the typhoon and their materials were not local – imported from another island or even across international borders in some cases where materials could be more sustainably sourced. Even in the face of this knowledge many organizations chose to ignore this information. Diffusion through textual sources, a key communicative mechanism, saw the rapid adoption and uptake by organizations. The Philippine coconut industry and the severe losses inflicted following the storm meant that this discussion was front and center in publicized media. The limited time allowed for this material to sit unused resonated with many Western ideas of lost project efficiency. In addition to a connection between local materials and local identity, NGOs appeared to also be driven by the need to not waste the resource, even given its less than ideal applications.

As mentioned, initial rationale for selecting coconut lumber became lost in later decisions. In this manner, the early emergence of choices had significant implications for processes in the future. Troublingly, many organizations held to collective organizational ideas in the decision process over immediate communication with communities, even in the presence of potential economic and time savings. This serves to demonstrate the influence that the cluster system and other inter-organizational procedures hold in the post-disaster decision context. It also speaks to the manner in which early response efforts were communicated. Textual sources held immense agency in conveying messages, allowing for individual translation by organizations that eventually led to the shift described above.

Organizations spoke of the immense autonomy that they have had in previous disasters as well as in the early stages of Haiyan efforts, such as one NGO worker here: *"It was explained that during the emergency and recovery there was a lot of autonomy on regards to decision that refers to the project manager, as the activities scale down moving to the next phase somehow that autonomy has been a little bit controlled."* As efforts transitioned to long term rehabilitation and recovery, the need to alter communicative practices with other NGOs and communities changed, driven by the return of local capacities.

While these protocols provided predictability for experienced disaster response organizations, they created obstacles for local governments and new organizations that lack familiarity with these decision procedures. Humanitarian responders found communication among themselves to be easier than with local populations and correspondingly sought out validation from their peers more than from their beneficiaries, self-reinforcing knowledge that was communicated within the NGO community. Not all organizations were consumed by collective information on material selection however. It was during this transitional period that many NGOs found ways to innovate and reframe the decision process. Some of the most success examples highlight that those organizations that adopted high levels of integration with communities and local socio-cultural identities saw the most significant gains. Rather than viewing local knowledge as something that could be extracted, they changed their decision practices in sometimes counterintuitive ways. Rather than decrease the number of stakeholders, one NGO actually brought in additional parties and perspectives, sub-contracting work to both additional international NGOs with technical expertise and to local businesses, in this case an architecture firm.

Limitations and Future Work

While this study was able to collect data in real time, a limitation of the study was its start date seven months after the disaster due to logistical considerations of entering a post-disaster context. Participants were asked not only to recount ongoing events at the time of collection but also retroactively account the initial months of the response that were influential in ongoing coordination.

Additionally, this study presents one contextual case that should be validated with future studies across different national contexts for comparison. While we have presented and linked the emergence of coordination structures and practice to early goals and objectives, further work should look to link the emergence of coordination to longitudinal outcomes of infrastructure.

Conclusions

In the words of Dwight D. Eisenhower, "Plans are nothing; planning is everything." This is certainly true for the case of post-disaster construction, where the complexity and dynamic environment demand for flexibility, ingenuity and collaboration. The goals and objectives of program planning were inherently linked to emergent structures and communicative processes, portrayed through the key elements above. A theme that surfaced in analysis was that many organizations focusing on reconstruction were faced with immense uncertainty and risk. This came in the form of land ownership, design standards, future relocation potential, cultural acceptance, scheduling, and cost. Not only did the communicative processes employed emerge to face this uncertainty, organizational goals were driven by minimization of risk. One of the Shelter Cluster managers summarized this:

> "Every disaster is unique so this idea of using a blue print from one mission to the next is limited, it is quite limited because I think the issue arises with the transition between emergency and transitional. When you are doing emergency response nobody knows if there will be a recovery phase for example, I think that was a bit the case here and then the recovery phase became apparent that it was needed so the funding was there and these projects are going on so you can't judge that in the planning phase or in the emergency phase."

In particular, there was a rapid inter-organizational adoption of goals that centered on provision of temporary and transitional shelter, rather than permanent solutions. This behavior drew from boundaries established though organizational structures and communication processes during planning such as diffusion of coconut lumber guidelines and uncertainty of the organizational environment. Stemming from internal forces within the cluster system, goals that emerged were often driven by localized dialogues that proliferated inter-organization systems. This served to exemplify a core lesson from present institutions: "strategies that are rational for individual organizations may not be rational if adopted by large numbers" (DiMaggio and Powell 1983).

In analyzing the emergence of coordination structures and practice, we provided evidence of the manner in which organizational behavior evolves following a complex crisis. In particular, this answers calls in the literature to provide rapid cross-national study of complex coordination (Drabek 2007). Investigating diffusion of practices, we have presented a framework which extends and validates a sequential model of adoption that includes structures, processes and goals that support rapid changes in humanitarian response. This supports recent research that periods required for practice change may be shortening for organizations that are increasingly faced with dynamic socio-political environments. Additionally, the findings suggest the need for policy makers to re-evaluate coordination systems to allow for more emergent means of communication and innovation in disaster response and recovery. Touched on briefly, one example of this is limiting resource demands for multi-lateral coordination mechanisms and considering bi-lateral means when efficiency needs prioritization.

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CHAPTER 3 ASSESSING THE IMPACT OF HOUSEHOLD PARTICIPATION ON SATISFACTION AND SAFE DESIGN IN HUMANITARIAN SHELTER PROJECTS

Abstract

Participation in disaster practice and theory has long been considered important for recovery; but establishing what constitutes participation in post-disaster shelter projects has remained elusive and the links between different types of participation and shelter program outcomes are not well understood. Further, recent case studies suggest that misguided participation strategies may be to blame for failures. We studied 19 shelter projects implemented in the Philippines following Typhoon Haiyan to identify types of participation employed and analyzed, using fuzzy-set comparative case analysis (fsQCA), how household participation in planning, design, and construction phases led to shelter outcomes of household satisfaction and safe shelter design. We operationalized participation via eight central project tasks, finding that participation of households in early planning stages of projects and control over construction activities was important for satisfaction and design outcomes, while participation during the design phase of projects had little impact on the selected outcomes.

Keywords: shelter, housing, participation, qualitative comparative analysis, Philippines, Haiyan

Introduction

In 2015, the United Nations estimated a funding gap of $15 billion dollars for humanitarian needs (Georgieva et al. 2016). This funding deficit is particularly prevalent in the shelter and settlements sector, which historically has relied on delivering outputs that are costly. As stated by Graham Saunders, "The scale of post-disaster shelter need that is increasingly emerging is beyond the response capacity of institutional humanitarians, be they governmental or non-governmental" (Davis 2011). The result is a growing emphasis placed on supporting 'self-recovery' and homeowner driven models of shelter and housing reconstruction (Maynard et al. 2017). These approaches will necessarily become the new norm for responding to disasters. The debate surrounding the benefits, pitfalls, and realities of participation in humanitarian shelter programming is therefore becoming increasingly important as humanitarian funding is stretched to meet a growing number of natural disasters and conflicts.

Emergent from neoliberal policies and the democratization of aid, participation has become a pillar of disaster assistance (Pyles 2011). At its core, participation of affected households and local governments has been associated with empowerment (Chambers 1997), cost-reduction (Ferguson and Navarette 2003), decentralization of governance (Ahrens and Rudolph 2006), and local knowledge (Hayles 2010). Yet, despite its central reoccurring role in disaster discourse, policy, and theory, participation in disaster recovery remains an ambiguous narrative, the result of vague operational definitions and the misrepresentation of consulting and informing as legitimate forms of participation (Davidson et al. 2007).

Entangled within efforts to support recovery, participation has taken on a plethora of definitions that are frequently derived from theoretical notions, rather than practical observations in disaster contexts. Further, the casual links between participation and shelter outcomes, both positive and negative, are too frequently anecdotal, and while temporality has seen emerging importance in disaster scholarship (e.g. Olshansky et al. 2012), past research of participation often neglects the important question of *when* (what project phase) different types of participation occur. Clarifying and operationalizing participation in humanitarian shelter and settlement projects, as well as understanding casual links to project outcomes, can better inform how governments and non-governmental organizations approach shelter assistance.

We echo calls made nearly 40 years ago by Cohen and Uphoff (1980) for 'clarity through specificity' of participation. In place of generalities, it is imperative that we understand participation as specific tasks that are situated within a project cycle. To date, much of the literature on participation in shelter poorly defines what actually constitutes participation and by whom, resulting in a spectrum of definitions and practices that are loosely associated. As such, we unpack types of participation observed in post-disaster shelter projects to address the research question:

RQ1: What types of household participation occur in post-disaster shelter projects?

In this study we will use the term 'shelter' to describe built household spaces, however we recognize that literature has interchangeably used 'shelter', 'housing', and 'habitat' to describe similar post-disaster interventions. Operationalizing participation in post-disaster shelter projects manifests as a theoretical problem, but more practically, there remains debate about whether participation leads to positive or negative shelter outcomes and when in project cycles participation holds influence (Prokopy 2005). While this problem is partially associated with lack of consensus as to what constitutes and defines participation in shelter projects, it also stems from limited cross case analysis within the field. To address this need, we ask our second question:

RQ2: How, and when, do different types of participation affect post-disaster shelter outcomes?

To explore participation, we selected to examine shelter projects following Typhoon Haiyan in the Philippines where nearly 1.1 million houses were damaged or destroyed in the aftermath and a large international humanitarian response followed. Haiyan presents a compelling case to study because of the large variation in approaches that emerged within the shelter and settlement sector. Within this paper, we first provide background on literature regarding shelter outcomes, participation, and the tenuous link between participation and shelter outcomes in post-disaster shelter programs. We then discuss our methods to identify types of participation, as well as fuzzy set qualitative comparative analysis, the method we used to analyze casual links between participation and shelter outcomes before providing and discussing our results.

Background

We first review shelter outcomes, focusing on two outcomes analyzed within this research – household satisfaction with the shelter and technically sound shelter designs. We then review participation in post-disaster shelter programs and existing work that has linked participation and shelter outcomes.

Shelter Project Outcomes

Shelter is universally recognized as a foundational element of disaster recovery; and while its ability to provide protection from the elements is a core function, shelter also contributes to re-establishing household routines (Peacock et al. 2007; Quarantelli 1982), simulating economic activity (Sheppard and Hill 2005), and restoring social ties (Mileti 1999). Previous literature has linked shelter to these specific benefits, as well as broader recovery (e.g. Jordan and Javernick-Will 2013a), and resilience outcomes (e.g. Cutter 2016; Kusumastuti et al. 2014). In practice, organizations have too often relied on coverage (e.g. numbers of households assisted) to measure the impact of shelter assistance, neglecting to assess whether shelter assistance actually provides its intended purpose. However, plentiful indicators have emerged to measure the *quality* of shelter project outcomes (e.g. Nath et al. 2016). Drawing from past literature (Jha et al. 2010), we selected to examine two outcomes – household satisfaction and safe shelter design – that portray the functionality of shelter to meet household needs and reduce future risk. Satisfaction of beneficiaries remains the most used measure of success for shelter projects (Piccioli et al. 2017). Safe design, in contrast, is understudied but a vital component of resilience (Bruneau et al. 2003).

Household satisfaction with shelter

Satisfaction with shelter has consistently been applied as a means of assessing the ability of shelter to meet household needs. For example, Snarr and Brown (1980) noted its ability to measure how well housing serves its function, departing from earlier measures which focused on the number of shelters completed. Barenstein (2009) used a similar measure to compare the 1993 Maharashtra earthquake, 2001 Gujarat, and 2004 Indian Ocean tsunami in the Indian context, and Rand et al. (2011) used satisfaction as an outcome following the 2004 Indian Ocean tsunami as means to assess the ability for shelter to meet and provide for household needs. In Bouraoui and Lizarralde's (2013) compilation of shelter satisfaction indicators, one-third of indicators identified focused on comparing existing housing, infrastructure, and services to the pre-disaster state. In assessing the outcomes of shelter *projects*, comparison to a pre-disaster state provides comparable data that can be examined across disaster contexts. As such, we followed similar studies (e.g. Barenstein 2006), and opted to measure household satisfaction by average perceptions of current shelter compared to original dwellings.

Shelter design and safety

The 2010 Haiti earthquake serves as an exemplary reminder of why safe shelter is important – in many cases poorly constructed shelter is often the cause of death in disasters. Additionally, access to safe shelter is identified as a key outcome in the 2015 Sendai Framework, achieved through *"universal design and the standardization of building materials"* (UNISDR 2015). Building codes offer an ideal standard for design, but are often unattainable for households in resource limited communities. Thus, assessing what constitutes safe shelter design can be difficult and is often highly dependent upon local construction methods and materials. Previous research has assessed the safety of post-disaster shelter largely through a comparison to previous conditions, such as Arlikatti and Andrew's (2012) study of shelter construction in India after the 2004 Indian Ocean tsunami.

In recent years, the Global Shelter Cluster has created key messages to promote safer shelter design and construction following disasters. Following Typhoon Haiyan in the Philippines, the Shelter Cluster created '8 Key Messages' that proposed design recommendations for households across eight themes: foundations, tie-downs, bracing, joints, roofing, shape, site location, and preparation. We omitted the last theme of preparation as it was not related to the design of shelter, but used the remaining seven key messages to assess the presence, or absence, of safe shelter design. In comparison to past studies which have focused on building materials or visual signs of deficient construction quality, our approach systemically analyzed structural details. Full details of our assessment methods can be found in (omitted for review, 2016).

Definitions of Participation

Participation has become so institutionalized in practice that it is unequivocally accepted as necessary in shelter projects. The abundance of titles for participation symbolizes how dispersed theory has become, taking on the names 'popular participation,' 'citizen participation,' 'community participation,' and 'user participation' over decades of research (Arnstein 1969; Cornwall 2006; Davidson et al. 2007; Sadiqi et al. 2016). While there are similarities in each of these constructs, these varying conceptualizations of participation invoke differing stakeholders and contexts. Most conceptualizations of participation stem from broader planning or development literature, such as Arnstein's (1969) 'ladder of citizen participation.' This conceptual framework was later adapted by Choguill (1996) for underdeveloped countries. However, disaster scholarship has remained content to adopt these theoretical frameworks of participation to the detriment of examining empirical examples of how participation surfaces in disaster practice. Many previous studies have neglected to define participation and, of those that do, there remains little consensus on a definition. In our attempts to create a generalizable theory of participation, we have lost specificity.

The application of planning and development definitions of participation have fixated on decision-making as a focal point, discounting other forms of participation, such as sweat equity, as token forms of participation. Vallance (2015) adeptly points out that participation in implementation, such as sweat equity, is often falsely used as a proxy for participation; however, there is little research that has tried to examine multiple types of participation in parallel. While there is truth behind these claims that 'sweat' participation should not be a substitute for agency of communities, this perspective neglects to understand the multiplicity of participation and the perceptions of those involved these activities.

We should seek to understand participation for what it is – a graded scale of decisions *and* actions (Lawther 2009).

As Davidson et al (2007) note, *"community participation in disasters has not been defined in terms of what it means in a project environment."* There have been anecdotal descriptions of what actions might constitute participation within housing and shelter projects; however, we still lack an organized framework of project tasks, both decision and implementation based, that can be used to measure participation of shelter projects. We found one example of a framework to define participation in post-disaster shelter from Da Silva (1980), who suggested that participation occurs across five tasks: management, financing, design, construction of components and assembly of components. In the context of this study, we propose that participation can be defined as the household inputs into shelter projects. We approach the operationalization of participation through a grounded perspective that examines project tasks in shelter planning, design, and construction.

Reviewing Links between Participation and Shelter Outcomes

There is a wealth of shelter case studies suggesting that participation is an essential part of successful shelter projects (Barakat 2003). The former Office of the United Nations Disaster Relief Coordinator (1982 p. 55) went as far as to state, *"The key to success ultimately lies in the participation of the local community – the survivors – in reconstruction."* However, a closer examination of literature reveals that our understanding of links between participation and shelter outcomes is less than conclusive. In a review of broader community-based development research, Mansuri and Rao (2004) found no studies that identified a causal link between outcomes and participatory project elements. Evidence from past post-disaster shelter research suggests that community involvement is necessary; however, full community control may not be needed to achieve outcomes, such as satisfaction (Kennedy et al. 2008).

Bouraoui and Lizarralde (2013) and Rand et al. (2011) found a positive link between participation in shelter projects and satisfaction of end-users, with Rand et al's study finding that participation during the *construction* phase was linked to user satisfaction. However, there is relatively little evidence on the impact of participation on safe shelter design. One study by Khwaja (2004) found a negative relationship between community participation in decision-making and infrastructure design outcomes, although this was not specific to shelter projects or the disaster context. We see from these, and other, studies, the evidence of the impact of participation on shelter outcomes varies greatly.

From these examples we can see that the relationship between participation and shelter outcomes is contingent upon the shelter outcome and type of participation analyzed. For instance, satisfaction has previously been analyzed in relation to decision-making participation during construction, but we found no studies that explicitly address other types of participation, such as labor, on this outcome. There are also methodical gaps in literature that have hindered our understanding of casual links of participation to shelter outcomes. Specifically, despite a strong foundation in disaster literature that supports a dynamic, non-linear understanding of recovery processes (e.g. Smith and Wenger 2006), the importance of when participation occurs during recovery has largely been neglected and few studies have examined shelter recovery in a longitudinal manner (Snarr and Brown 1980, 1982, 1994). Therefore, there is a need to contextualize the use of participation within longitudinal studies to understand how involvement during planning, design, and construction impact shelter outcomes (Kelman et al. 2011; Peacock et al. 2007). As a result, we focus on analyzing the impact of participation across project phases on the outcomes of household satisfaction and shelter design.

Methods

For researchers looking to use comparative methods in disasters, one of the most challenging problems is the ability to achieve a sufficient number of cases to compare, particularly when the unit of analysis is the project. We chose to define a 'project' as shelter assistance provided by a single organization within a barangay, the lowest political division within the Philippines – our research context. While thousands of households might receive shelter assistance, there are a small number of programs responsible for assisting these masses. For example, in response to Typhoon Haiyan in the Philippines, the Shelter Cluster reported that 71 organizations were responsible for assisting 344,853 households (Shelter Cluster 2014d). While this number of organizations is sufficient to consider statistical methods of comparing programs, collecting this data of sufficient detail is prohibitive. As a result, case studies have become the norm for investigation of post-disaster shelter projects. The value of case study research in disasters should not be discounted, but the core limitation of these methods is the ability to generalize. Recognizing the limits of past studies on participation, we sought to examine a larger number of cases within a single disaster context using a novel method, fuzzy-set qualitative comparative analysis (fsQCA).

We will first describe our research context, the data we collected, and will then discuss methods used to address each research question. During the first phase we aimed to create a typology of participation and develop a set of conditions which could be used to analyze their impact on the selected outcomes. In our second phase, we discuss the links between participation and the shelter outcomes of household satisfaction and safe shelter design.

Research Context

We studied post-disaster participation and outcomes following Typhoon Haiyan in the Philippines in 2013. Haiyan affected more than 16 million people and was responsible for damaging or destroying more than 1.1 million homes in its path (Shelter Cluster 2014d). In consultation with shelter organizations involved in the response and recovery, we selected 19 shelter projects to study over a three-year period. Projects were selected in the provinces of Cebu, Leyte, and Eastern Samar – each community experiencing extensive damage, differing implementing organizations assisting with shelter, and variation in participation approaches. Further, all of the projects were selected during the planning stages prior to the start of substantial design or construction activities, in order to follow each project through all project cycles. A list of the communities selected and shelter assistance details are provided in Table 3-1.

Table 3-1: Project and Community Overview

Case	Community	Municipality	Province	Population	Households assisted	Shelter categories
1	Okoy	Santa Fe	Cebu	3,532	230	3
2	Maricaban	Santa Fe	Cebu	2,999	118	6
3	Poblacion	Santa Fe	Cebu	2,345	40	3, 6
4	Sungko	Bantayan	Cebu	3,296	183	1, 2
5	Sillon	Bantayan	Cebu	4,064	75	3
6	Kangkaibe	Bantayan	Cebu	2,635	348	3, 6
7	Tagpuro	Tacloban City	Leyte	677	86	2
8	Pago	Tanauan	Leyte	917	365	6
9	New Kawayan (101)	Tacloban City	Leyte	543	148	1
10	Bagacay (93)	Tacloban City	Leyte	3,936	150	3
11	San Agustin	Jaro	Leyte	824	45	3
12	San Jose (83C)	Tacloban City	Leyte	2,548	42	3
13	Magallanes (52)	Tacloban City	Leyte	1,304	199	1, 2, 3, 4, 5
14	San Jose (85)	Tacloban City	Leyte	1,572	234	1
15	Hiabangan	Dagami	Leyte	958	165	1, 3
16	Sagkahan (62)	Tacloban	Leyte	1,434	484	1, 3, 4, 5
17	Sulangan	Guiuan	Eastern Samar	3,597	63	1, 3
18	Cogon	Guiuan	Eastern Samar	1,146	133	2, 6
19	Cantahay	Guiuan	Eastern Samar	1,118	105	3

Shelter categories: [1] Repair and retrofit; [2] Transitional shelter; [3] Core/progressive shelter; [4] Rental subsidies; [5] Hosting support; [6] Resettlement

Each project is categorized by the type of shelter assistance provided. Repair and retrofit programs upgraded structures with minor damage, transitional shelter served as an interim solution for relocated households, and core/progressive shelter provided a basic structure that could be expanded over time. Rental subsidies provided cash for renters, hosting support provided access to cash for joint family living arrangements, and resettlement projects involved construction at new sites, often distanced from previous coastal hazards. We excluded households receiving shelter assistance from other organizations outside of the primary project considered within a community. For example, in one community there were three organizations assisting households with shelter assistance; we bounded our analysis to only those households receiving assistance by the organization we identified for inclusion in the study. For each of the shelter projects selected, we collected interview, documentation, and observation data during field visits at 6, 12, 28, and 36 months' post-disaster.

Data Collection

During our first field visit spanning four months, we conducted 32 semi-structured interviews with non-governmental (NGO) staff, local government officials, and community members involved in selected communities. Participants stemmed from international and domestic NGOs, local government units (LGUs), the Shelter Cluster, and the WASH Cluster.

Interview questions during this initial fieldwork focused on understanding how organizations involved, or did not involve, households in the early planning and design of shelter assistance. An example interview question to organizations was: *"How are you involving beneficiaries in your shelter projects?"* and to households was: *"How are shelter designs being determined?"* In addition to interviews, field notes were recorded from daily observations of reconstruction projects, cluster coordination meetings, and internal organization meetings. These notes encompassed dialogue that occurred during meetings and observation of stakeholder interactions in on-site planning activities. Finally, cluster policy documents, meeting minutes, recovery plans, and technical communication documents were collected.

A second, three-month field visit was conducted four months later, during which an additional 167 interviews were conducted with stakeholders. Individuals were selected based on continuing reconstruction efforts in projects identified during the first phase. Questions again centered on types of participation that were occurring; however, we emphasized participation within the design and construction phases. Example questions included, *'What is being requested of beneficiaries during construction?'* and *'What were you asked to contribute?'* Our third, three-month field visit occurred post-project completion. During this visit, in-person surveys were used to collect data on shelter project outcomes. In total, 320 surveys across the 19 shelter projects were administered. Relevant questions to this research included asking households to evaluate their current shelter compared to their dwelling before the typhoon and a visual assessment of structural characteristics of shelters. These questions were asked verbally using a translator, similar to the semi-structured interviews, and responses were recorded using a tablet. A final two-week field visit was completed to follow up on missing data and triangulate conflicting information through 12 additional interviews with organization staff and households.

Phase 1: Operationalizing Participation in Post-Disaster Shelter

Data Analysis

All interviews were translated, transcribed, and then imported into QSR NVivo qualitative coding software where data was inductively coded into participation themes. Coding was completed independently by two researchers prior to inter-coder comparison testing to verify themes in the data (Campbell et al. 2013). After themes were determined, inter-rater reliability scores in the form of Cohen's Kappa coefficient were computed for comparison on a 20% sample of interviews. Kappa coefficients, statistical measures of inter-coder reliability, represent a more robust measure over simple agreement measures as they take into consideration the amount of agreement between coders that is likely to occur by chance. Values in excess of 0.4 are generally considered acceptable (Landis and Koch 1977). In the case that this threshold was not met for the coding of any interview, the two researchers revisited the coding to reach consensus. Coding queries were then used to summarize themes across projects for each condition.

Results

From our qualitative analysis, we found eight conditions that characterized participation in shelter projects which we then categorized into the planning, design, and construction phases of projects. The planning conditions included: (1) determination of aid and (2) location selection. Design conditions included: (3) floorplan and layout and (4) government permitting. In the construction phase, conditions included: (5) sweat equity, (6) material procurement, (7) financial management, and (8) oversight. A summary of condition definitions is provided below in Table 3-2.

Table 3-2: Condition Definitions

	Condition	Definition
Planning	**Determination of aid**	The involvement of households in formal needs assessment processes, either through a third party or the implementing shelter organization.
	Location selection	The ability of households to have agency in deciding the site of their shelter.
Design	**Floorplan and layout**	Household have the ability to control decisions regarding the layout and design of their shelter.
	Government permitting	Formal documented approval by the local municipality or city for the location and design of shelter interventions.
Construction	**Sweat equity**	Unpaid labor contributions during construction that may consist of either skilled or unskilled tasks.
	Material procurement	Obtaining materials required to complete construction of planned shelter.
	Financial management	Household management of financial resources required to complete shelter, including labor, materials, transportation, and other essential tasks.
	Oversight	The supervision of construction tasks by beneficiary households.

Planning Phase

The first decision observed in shelter projects was who, and where, to assist. ***Determination of aid*** is different for each organization, but was distinguished by whether a formal assessment was conducted. Some shelter programs established needs through third party assessments, such as by a government municipality. Combined with reported damage levels, organizations often pre-determined shelter approaches, such as repair kits for regions identified to have minimal damage, limiting participation of households. Other organizations opted to conduct their own assessment, gathering local perspectives before making program decisions of how to best implement shelter assistance. Finally, others negotiated with donors to allow communities to determine their own needs before identifying shelter as the best means of assistance.

The decision of ***location selection*** was the second task identified during the planning phase which was pertinent to participation. The coastal 'no-build' zones shaped many location decisions, as described by one shelter beneficiary, *"Yes, they informed us about the shelter assistance, and that relocation for* *all those from the no-build zone is compulsory, for they considered the 50-meter from the shore as danger zone."* In some cases, however, organizations sought to provide choice within relocation, *"During one of the meetings [with the project manager], he left us to decide where we wanted our house in the relocation site. He had with him an illustration of the relocation site and he let everyone identify which region we wanted our house built, the color of it, and whom we wanted as our neighbors."* While choice was eventually afforded in later stages of site planning, we can see that attempts gravitated toward informing rather than placing the decision in the hands of households.

Design Phase

Floorplan and layout of shelters were dictated in some cases, while other programs allowed for flexible options for households to select configurations of rooms, windows, and doors. Within design there was also the critical question of what materials to use in shelters, as engineers have long advocated for more resilient materials in addressing risk (Bosher 2014). Material selection dictated sourcing, cost, and labor, each impacting shelter outcomes uniquely. Some might consider material selection a separate characteristic or participation decision from the floorplan and shelter layout, however across all cases we saw these were inseparably linked. We saw noticeable differences in participation that either leaned toward consultative processes or forfeited control to households.

While our initial focus was on household participation, the role of local governments in shelter projects emerged as an important and complementary type of participation. In particular, noticeable differences in project outcomes between high and low levels of government participation led to our inclusion of this condition within the design phase of projects. ***Government permitting*** of shelter designs allowed for additional cultural insights and provided institutional protections for shelter assistance, such as recognition of land agreements. Few government departments were willing to outright reject humanitarian organization designs for fear of losing assistance; thus, participation of local governments was largely consultative but allowed governments to react to planned shelter activities and incorporate these actions into larger reconstruction plans.

Construction Phase

One of the most controversial types of participation, ***sweat equity*** has largely been examined in isolation from other types of participation, despite the fact that is often highly embedded within social norms or modalities of delivering assistance. We expected to see this form of participation based on past literature which was confirmed by our field observations. Common unskilled labor tasks included clearing sites, moving materials, and excavation. In some cases, if a household member had previous construction knowledge, they were asked to participate in technical tasks such as framing walls, masonry placement, and roofing. Requirements for sweat equity ranged from encouraged participation up to 2,000 logged hours per beneficiary household.

Material procurement, or the acquisition of construction materials, was another construction task that was identified to vary across projects. We observed that beneficiaries were either required to procure materials through designated suppliers or identify their own suppliers. In some cases, payments were handled in advance through the organization, thus procurement was not an entirely cash process and separate from our financial management condition below. In other projects, materials procurement was handled directly by the organization. Where the organization procured materials, the most common reason was related to concerns of local material quality.

Financial management by beneficiaries was yet another category of participation which was drawn from literature, and confirmed by our field observations. Past research has suggested that not only is owner managed reconstruction cheaper, but also quicker (Schilderman and Lyons 2011), making it a valuable condition to include in our subsequent analysis. The most common example of financial management that we observed was associated with conditional cash transfers, where the household was responsible for hiring labor and obtaining needed resources for construction. This required the household to oversee the use of project finances and reallocate resources as required to ensure construction activities were accomplished.

Previous research has also noted the increasingly important role of ***oversight*** during construction. Past studies have shown that organization and household supervision of construction activities ensures quality control of housing and leads to more durable structures (Davidson et al. 2007; Jordan et al. 2016). Examples of oversight included inspections by both households and the implementing organizations as well as checklists to verify construction was in compliance with designs.

Phase 2: Casual Links between Participation and Project Outcomes

Data Analysis

In the absence of rigorous small-N case comparisons in humanitarian shelter research, we selected to use fuzzy-set qualitative comparative analysis (fsQCA) to examine how, and when, participation of households is important in shelter projects. fsQCA offers a middle ground between case studies and statistical analysis, retaining complexity within cases, while still offering the ability to generalize findings through robust comparisons (Ragin 1987). A particular outcome of interest is identified (e.g. household satisfaction) along with conditions (e.g. location selection) posited to affect that outcome. The method draws from Boolean algebra and set logic to analyze how conditions, in combination or isolation, compose 'pathways' to the desired outcome.

Variable calibration

Building upon the first phase of the research, we analyzed eight types of participation and two shelter outcomes that surfaced from shelter projects. We also added a ninth condition, value of aid, in order to account for projects that had substantially higher resources allocated per household to explain potential differences. QCA relies upon a set theoretic approach, which contrasts traditional statistical methods that use correlational measures. We first needed to calibrate our raw data. Preliminary anchor points, membership and non-membership, for each condition were established and a level of precision for the set was selected based upon classifications that emerged from the qualitative coding summaries (Basurto and Speer 2012). For participation conditions with a greater number of distinct classifications of cases, a higher number of set scores were used. Cases with only two classifications were turned into binary, or crisp, sets. Finally, each of these qualitative classifications were assigned specific fuzzy values. Table 3-3 is an example calibration for oversight during the construction phase. We coded the other seven participation conditions following similar steps using the indirect calibration method. The full list of calibrations can be found in Appendix E.

Table 3-3: Example Variable Calibration

	Oversight
0	No inspection of construction.
0.3	Organization and household members inspected shelter at sporadic milestones, however no action was observed on items requiring rework or modification.
1	Organization and household members inspected shelter at major milestones. Action was observed on items that required rework or modification.

We calibrated the outcomes of household satisfaction and shelter design as well as the value of aid condition using a direct method. In contrast to indirect calibration, which relies on qualitative sets, direct calibrations use interval-scale data and relies on three qualitative breakpoints to structure the set. The researcher defines full membership (0.95), the crossover point (0.5), and full non-membership (0.05). These theoretically defined points are then used to transform the original interval-scale data into a fuzzy scale using transformations that use the log odds of full membership (Ragin 2009).

Using the example of value of aid, the first step was to set breakpoints using theoretical and case knowledge. As a part of our data collection, we determined the average monetary value of assistance provided to households for each shelter project. We then defined our anchor points using estimates compiled by the Shelter Cluster (2014c), selecting P20,000 for out-of-set membership, aligning with an expected cost for major repairs, and P185,000 for in-set membership, aligning with the expected cost of a permanent shelter. The point of maximum ambiguity was set at P85,000 as this estimate was for a 'core' shelter that did not include basic components, such as a kitchen or latrine, and was thus designated as our crossover point. Using these anchor points we then used log odds to calibrate our sets and assign fuzzy values to each case.

Analyzing casual conditions

After calibrating the selected conditions and outcomes, we compiled a truth table and performed our analysis using fsQCA software (Ragin et al. 2008). The full truth table used for the analysis is shown below in Appendix C. fsQCA relies on two primary measures in order to assess 'causal recipes' of conditions: consistency and necessity. Consistency is the degree to which one condition (or combination of conditions) is a subset of another condition (Jordan et al. 2011). The second measure, necessity, considers whether an outcome is comprised of a subset of instances of a particular condition. The term 'coverage' is often substituted in place of necessity when discussing combinations of conditions in a solution. The equations used to calculate consistency and necessity are shown in equations 1 and 2 below. Acceptable values of consistency are typically 0.8 for sufficient conditions (or combinations of conditions), while necessary conditions are those with values of 0.9 or greater (Ragin 2008). The respective equations to determine these measures are shown below.

$$Consistency = \frac{\sum \min(X_i Y_i)}{\sum X_i} \quad (1) \qquad\qquad Nessessity = \frac{\sum \min(X_i Y_i)}{\sum Y_i} \quad (2)$$

In QCA, the logic space is defined as all the possible value combinations of conditions (Ragin 1987). In order to reduce our logic space we made simplifying assumptions as to the expected theoretical direction of relationships between each condition and outcome (Ragin and Sonnett 2005). A list of simplifying assumptions is provided in Appendix D. For example, we would expect that allowing households to select the location of their shelter would result in greater household satisfaction. Following a preliminary screening of analyzing individual condition necessity with respect to the three outcomes, we then performed a subset/superset analysis, which seeks to identify if there are any conditions that can be removed from solutions. This step analyzes the consistency of groups of conditions to identify common denominators. The result was final causal pathways that describe different combinations of participation resulting in the presence, or absence, or household satisfaction, shelter design. A notable characteristic of QCA is equifinality, or the concept that an outcome can be achieved through different means, thus we found more than one combination of conditions leading to the outcomes of interest.

Findings

We discuss our findings for each outcome individually and then conclude with a discussion of themes identified across the outcomes and projects. In the following sections we present the solutions identified for each outcome in a diagram. A "~" denotes the absence of a condition and a "*" denotes the "and" Boolean operator.

Shelter Satisfaction

Shelter projects broadly received high levels of satisfaction, measured in comparison to pre-disaster shelter. We still noticed variation in the levels of satisfaction achieved however, which we analyzed with identified participation conditions. Thirteen of the shelter projects showed signs of household shelter satisfaction and were included in the outcome membership set, while six projects exhibited low satisfaction. From our analysis, three participation pathways surfaced with an overall consistency of 0.94 and a coverage of 0.69. Pathways to household satisfaction with shelter are shown in Figure 3-1.

For the first two pathways found, core components included a high value of aid and government permitting of shelter plans. The importance of access to sufficient value of aid was described by one household when asked if the materials being used in reconstruction were better than those prior to the typhoon, *"It depends, because those who are in the higher income brackets can afford to buy good quality materials, while those who earn less just settled for the ordinary materials. If we opt to use good lumber, the allocated budget for the materials will be insufficient, so we had to settle with what can suffice with the resources available."* In addition, either location selection or a combination of determination of aid and sweat equity was also required. The first of these pathways covered five of the thirteen cases that showed high satisfaction and the second pathway covered three cases. Households frequently noted that their satisfaction with shelter was often a product of where they were allowed to build. For example, one relocated beneficiary who was dissatisfied described, "W*e do not have transport service to go fishing again."* This causal link between household satisfaction and location is well established in literature (Rumbach 2014), yet we continue to see programs neglect the social and economic dimensions associated with shelter location.

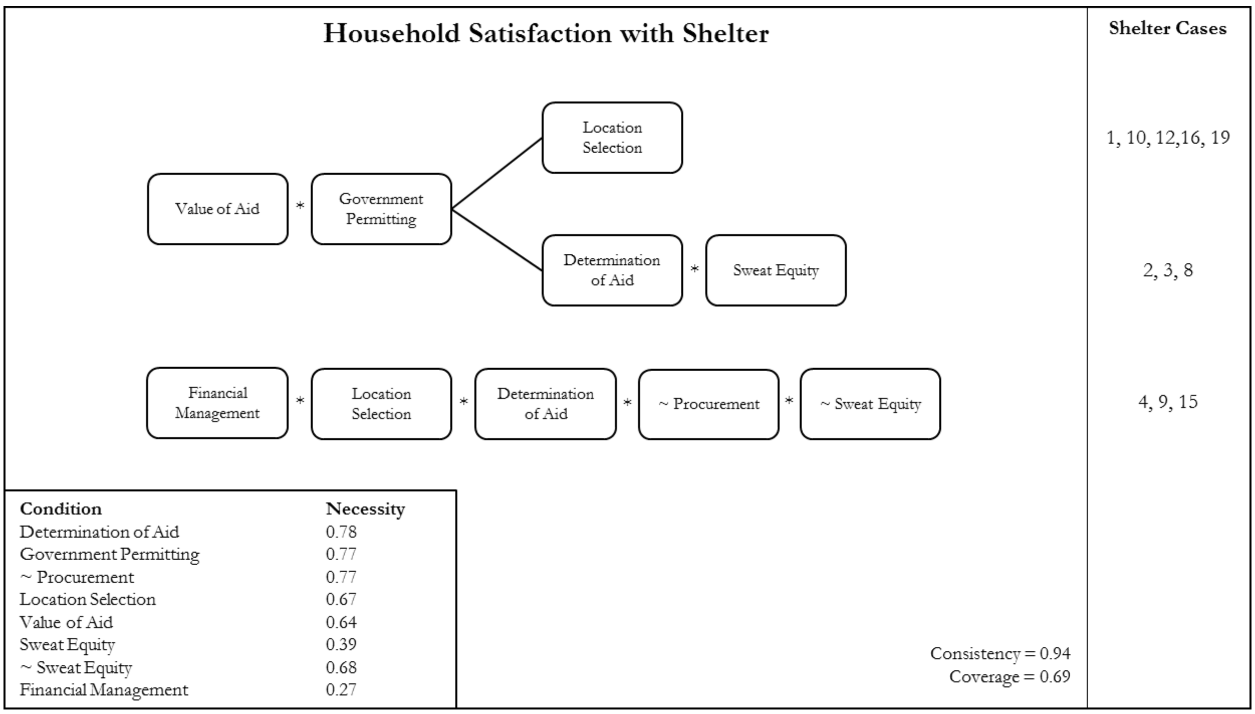

Figure 3-1: Household Satisfaction Pathways

Interestingly, we see that all three of the cases included the second pathway were relocation projects, where participants were not involved in selecting the location of their house, suggesting that participation in early needs assessments and sweat equity were able to substitute for decision-making of location for satisfaction. While resettlement should only be considered as a last option, in select cases it may be necessary. The third pathway covered three cases, however it is distinguished by greater control over financial resources. The pathway also included location selection, determination of aid, the absence of procurement, and the absence of sweat equity. In other words, households did not need to be involved in construction tasks, but did need to retain decision-making authority in both planning and financial management of construction activities. Again, we see a notable trend in the cases that fall into this pathway in that each was a repair and retrofit project that involved material distributions.

Surprisingly, we did not find that household participation during the design phase of projects was included in any of the three pathways to satisfaction. To reiterate, we distinguished between involvement and control over design decisions, the later constituting in-set membership. In line with past studies (Kennedy et al. 2008), our findings suggest household control of design decisions was not a necessary condition for satisfaction. More often, we found that satisfaction was derived from the size and durability of shelter, irrespective if these decisions were made by the beneficiary or not, noted by one respondent, *"We don't care that much on the physical aspects of the house, what we're after is a strong structure and its size; one that will fit our whole family."* This is not to suggest that beneficiary input was not important, contrary, we found that involvement in consultation meetings shaped desirable solutions developed across all of the projects.

We hypothesize that government permitting may be an important condition for satisfaction, in part, because of its ability to secure land tenure which establishes permanency and allows households to invest greater resources in shelter without fear from eviction. We also saw that government permitting played a role in shaping culturally appropriate and practical designs. For instance, one government official noted changes they recommended, *"Some of the modifications that we were able to ask from the [NGO] were adding a kitchen sink to their design and providing a door on the side so that if the family would have more resources to add, for example a kitchen or a latrine, then it would be very accessible."* For this project, 87% of households had expanded within a year of turnover – one of the highest rates across the project studied – demonstrating that government participation had a tangible impact.

Safe Shelter Design

Eleven of the shelter projects showed inclusion of greater than five of the '8 Key Messages,' our measure of safe design. Observations of seven of the conditions was considered to constitute set membership, while incorporation of fewer than three messages denoted the absence of safe shelter design. We identified four pathways that had a collective consistency of 0.88 and a coverage of 0.80. Government permitting was found to be a necessary condition, with a necessity score of 0.93. The first three pathways all included government permitting and the absence of household participation in floor and layout decisions. These pathways signify a high level of control over design by the implementing organization and the local government. Pathways to safe shelter design are shown in Figure 3-2.

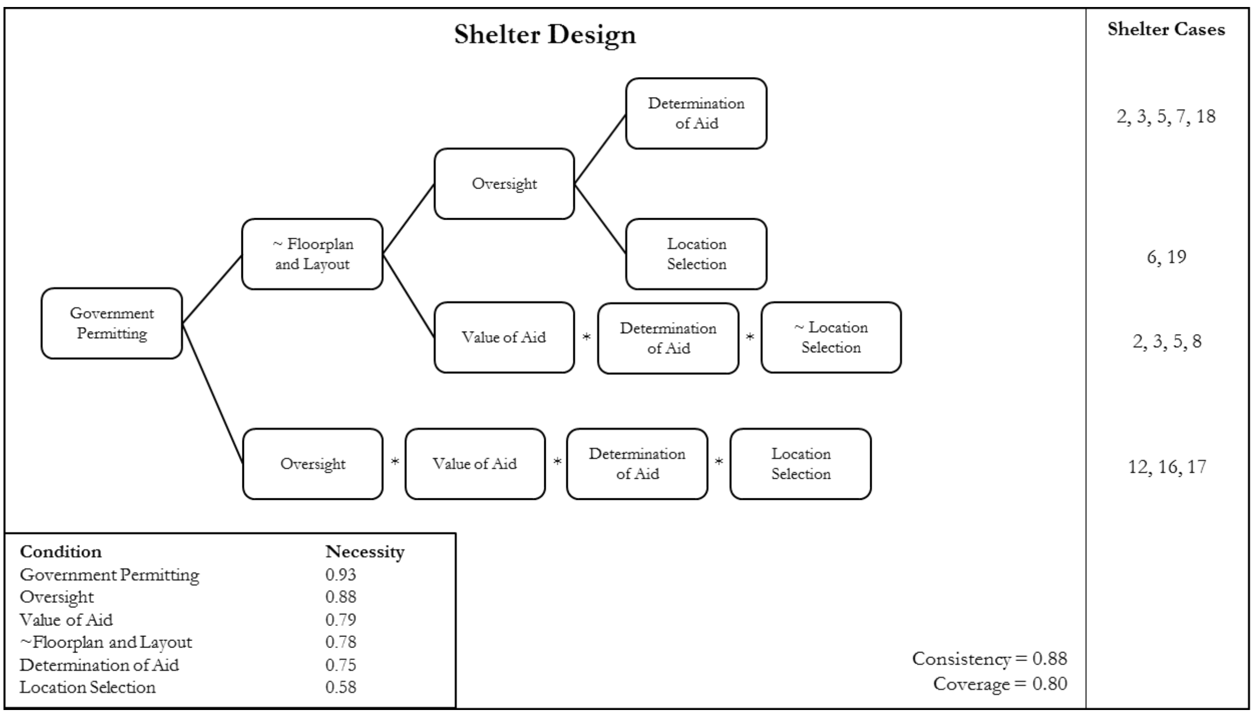

Figure 3-2: Shelter Design Pathways

The first pathway included five of the eleven cases that showed signs of safe design, while the second pathway included two cases. The first two pathways also included oversight during construction, with either determination of aid or location selection. Oversight was important in these pathways because of the ability to ensure that construction met intended guidance, regardless of whether design decisions were made by households or the organization. As all of the cases that fell into the first pathway were relocation projects, the damage levels experienced by the beneficiaries for these projects were typically higher, leading early assessments to prioritize safety in shelter design. In contrast, the second pathway included nearly the same conditions, but had location selection in place of determination of aid. The third pathway contained determination of aid, value of aid, and the absence of location selection. There was overlap in three of the cases for the first and third pathways. Value of aid emerged in place of oversight, suggesting that with sufficient resources, households were able to self-select design components that were more robust. Labor participation was common across all cases in the third pathway, however project 8 was distinct in that households were not involved in oversight processes during construction, thus the reason for a separate pathway despite the other three cases appear in the first pathway.

The last pathway included three of the eleven cases with safe design elements, and included oversight, value of aid, determination of aid, and location selection. In opposition to the high level of organizationally imposed control during planning and design in the first three pathways, the last pathway demonstrates an alternative mechanism of achieving safe shelter design. We see that the first three pathways achieve design through prescribed requirements, while the last pathway does so largely through incentives. One of the cases in the last pathway relied on an owner-driven model that used a three-tranche conditional cash transfer. This delegated individual compliance with design standards to households, requiring that minimum standards were met before the next cash transfer was completed. A second project in this pathway placed the responsibility of meeting design standards on local contracting teams. The last project in this pathway used volunteer labor to construct shelters. These shelter modalities, however, required significantly more financial resources per household – the average value of aid of these three cases was 33% higher than the overall project average.

Government permitting surfaced as a necessary condition for safe design and oversight was nearly necessary. This supports past research which has identified the important role of oversight during construction (Jordan et al. 2016). Government permitting is a logical participation condition to expect for design, yet little research has examined the role of local government in approving designs and synchronizing settlement patterns. In half of the pathways discovered, we notice that a high value of assistance was required to achieve improved design. None of the repair and retrofit projects, all of low monetary value, achieved the design outcome, suggesting there is a threshold of resources required to obtain a high level of design. This finding also suggests there is a need to more closely examine technical assistance programs to understand resource constraints and other factors limiting the adoption and uptake of safer design principles.

Discussion

In our first phase, we identified eight different project tasks that varied in their level of household participation. Half of the conditions identified were in construction, suggesting that much of participation in the observed shelter projects surfaced in the later stages of shelter projects. The number of participation conditions should not however be confused with their relative importance, demonstrated through our subsequent analysis (e.g. the importance of location selection).

Foremost, high value of assistance appeared in a large number of the pathways to satisfaction and safe design, but its appearance was inconsistent. Alternative pathways where high monetary value does not appear merit particular attention because they hold insights for humanitarian organizations faced with financial constraints. Household financial management was found to be key for satisfaction in the absence of high value of aid, showing promise for modalities that seek to support 'self-recovery' and owner-managed reconstruction. However, financial management did not appear in any of the pathways for safe design. This may stem from fewer resources allocated to technical support for low value projects, such as material distributions.

Surprisingly, we did not find that household participation in the design phase appeared in any pathways. While this contrasts theoretically conceived outcomes of participation, this finding aligns with emerging studies that are empirically grounded which note that the importance of household control over designs is often overstated (Rand et al. 2011). Participation during the planning phase appeared almost universally across the two outcomes and we can thus conclude that earlier decisions were more influential in shaping shelter project outcomes. It may be logical to assume that design outcomes are tied to design decisions, but from our analysis we were able to trace many of these decisions back to precursors in location selection and needs assessment. However, government participation during the design phase was found to be important across the outcomes considered, suggesting that there is a critical need to align shelter projects with broader recovery strategies emphasized by local governments.

In line with past research (e.g. Vallance 2015), labor participation was largely absent from the pathways. We did see that significant sweat equity could lead to high satisfaction, but this participation was often highly intensive, amounting to hundreds of hours contributed across multiple months in the cases that led to high satisfaction. One beneficiary described how this labor investment led to satisfaction, *"We were more than happy to give a hand because those were our houses. We worked mornings and afternoons on the site. I was able to observe how the houses were built. I saw that the proportion of cement to gravel in each house was relatively higher. We really witnessed how the volunteers worked impressively on the houses. The materials were optimized and the gravel was all mixed compactly. The construction of the houses was not mediocre."* This satisfaction was achieved at a cost however, as many households that fulfilled these intensive sweat equity requirements had difficulty retaining paid employment to support household necessities during these labor periods. One beneficiary described the impact of the requirements, *"My daughter was taken care of by my mother just so we can work there every day. We borrowed money and rice too, because we had no income that time. It took us a month and two weeks to complete the 400 hours sweat equity by working eight hours daily, six days a week."* Projects that mandated small labor hour requirements, typically between five to forty hours, did achieve the same levels of satisfaction without as large of a burden on the beneficiaries. Further, we did not see sweat equity or procurement appear in safe design pathways, reinforcing that 'sweat' participation had little impact on other project outcomes. While we recognize that sweat equity can be a mechanism to promote ownership, too often the requirements hindered economic recovery for households.

Of the conditions identified and analyzed, location selection and determination of aid consistently appeared for both outcomes. The question of where to build shelters, particularly in cases where physical hazards such as storm surge are present, is often overlooked. Not only does location provide social and economic linkages, but in the case of our outcomes, we also saw this was key to safe design, as households were more likely to invest in shelter knowing their presence would be secure. Similarly, participation of households in identifying needs was a predecessor of establishing project modalities. For projects that did not conduct a formal needs assessment, the modalities were often poorly aligned with household shelter needs.

Limitations

While our work has taken significant steps to operationalize participation in post-disaster shelter, we recognize that there are several limitations of study. Foremost, participation alone does not explain all of the variation in the outcomes observed. Combining participation with other aspects of projects may yield additional insights. Further, a limitation of QCA is its inability to theorize on non-observed cases in pathways, termed logical remainders. We hypothesize that other contexts may be able to complete some of these and fill in our logic space. We have, nonetheless, taken a substantial step in advancing systematic cross-case analysis of post-disaster shelter.

Conclusions

Participation frameworks are plentiful in literature, but there is sparse research that has operationalized and measured participation in post-disaster shelter projects. To address this gap, we examined 19 shelter projects following Typhoon Haiyan in the Philippines, taking a grounded approach to identify forms of participation that surface in shelter projects. Through our analysis, we identified eight types of participation in project tasks that included: (1) determination of aid; (2) location selection; (3) floorplan and layout; (4) government permitting; (5) sweat equity; (6) material procurement; (7) financial management; and (8) oversight. We found that these tasks aligned with the planning, design, and construction phases of shelter projects. The resulting typology of participation conditions provides a means to assess and operationalize participation in post-disaster shelter projects, answering calls to specify and define what participation means in a project environment (Davidson et al. 2007).

Using participation conditions identified in the first phase, we then assessed their relative importance in leading to two shelter project outcomes – household satisfaction with shelter and safe shelter design. Early participation in planning was found to be essential, but projects could lead to satisfaction through either high value of aid provided, or alternatively, through household management of project finances. Household participation during the design phase did not appear in satisfaction pathways, aligning with previous research that has suggested involvement is necessary, but control is not required to achieve satisfaction outcomes (Kennedy et al. 2008; Rand et al. 2011). Safe shelter design was found to be primarily accomplished through organizational and governmental control over project processes, however we did find a limited number of cases that resulted in a high level of design from household participation during planning and construction. This finding builds on previous theory which has posited that control over technical decisions by non-technical individuals may lead to poor design outcomes (Khwaja 2004).

There are several lessons that can be drawn from this research. First, discourse of participation in post-disaster shelter projects should recognize a diversity of tasks that constitute participation. 'Sweat' participation is often discounted as insignificant, but as we have demonstrated, there is potential for it to further project goals. Organizations that seek to use such strategies should recognize that this type of participation has the potential to become tyrannical in nature if adequate evaluations of time and resources contributed by beneficiaries are not undertaken (Cooke and Kothari 2001). Second, as demonstrated by the equifinality of our solutions to reaching outcomes, there is no one answer to participation. Many of the combinations found included differing types of participation, yet reached the same outcome. Organizations should tailor household participation to their individual modality of delivering shelter assistance. Finally, our research challenges previous conceptualizations of participation (Arnstein 1969; Choguill 1996), notably that informing and consulting processes do not yield value. Rather than idealizing participation as control, we suggest it should be viewed as the collaborative pursuit of project tasks and goals.

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CHAPTER 4 HOUSEHOLD CONSTRUCTION KNOWLEDGE ACQUISITION IN POST-DISASTER SHELTER TRAINING

Abstract

The incorporation of safer building practices into shelter after disasters continues to plaque recovery efforts. While limited resources are one potential cause, evidence from case studies suggests that poor adoption of safer construction may stem from a knowledge deficit. Despite these shortcomings, previous research has done little to examine the current state of construction education and training in shelter and housing, and there is lacking evidence to support how households acquire new knowledge of construction practice. Examining nineteen shelter projects in the Philippines following, training methods were categorized using Kolb's experiential learning theory poles. Fuzzy-set qualitative comparative analysis was then used to analyze the impact of these methods on community construction knowledge. Findings reveal that households acquired knowledge either through a combination of formal training methods that encompassed reflective observation, active experimentation, and concrete experiences or alternatively through observation of on-site construction activities.

Keywords: shelter, training, fuzz-set qualitative comparative analysis

Introduction

The principle of 'build back better' has been a driver of humanitarian shelter response for the last two decades. The meaning of this tagline has been explored with rigor (Kennedy et al. 2008; Rahmayati and Haigh 2016), leading to an ever growing body of research that explores the drivers of improving the quality of shelter rebuilt for, and by, those affected by disaster. In particular, the mantra has resulted in refocused efforts to not only restore building practices, but address underlying knowledge gaps among local building construction stakeholders. Despite new insights, there continues to be disproportionate disaster damage to housing in low-income countries (UNISDR 2016). Further, the scale and frequently of disasters has led to a strained humanitarian system struggling to keep pace in responding with shelter needs (Georgieva et al. 2016).

Given these challenges, there is increasing recognition of the need to transform 'the way reconstruction programs are conceived and implemented' (Turnbull et al. 2015 p. 58). Part of this transformation involves implementing organizations shifting from a focus on delivering products to facilitating processes in disasters. Though such approaches, affected populations are rightfully gaining a central role in shaping their own recovery. Training and education are becoming necessary components of humanitarian shelter assistance, cited as crucial in building capacities that aid hazard mitigation and safer building techniques. The Sendai Framework goes as far as to, "Promote the incorporation of disaster risk management into post-disaster recovery… through the development of measures such as land-use planning, structural standards improvement and the sharing of expertise, knowledge, post-disaster reviews and lessons learned rehabilitation processes…" (UNISDR 2015).

More broadly, however, we do not fully understand how individuals and households acquire safer construction knowledge after disasters and whether this knowledge is applied in practice. To do so, we need to better understand current construction training methods used for post-disaster shelter, and how these relate to longer term household construction knowledge. Therefore, we ask:

RQ1: What construction training methods are used in humanitarian shelter projects?

In the context of the research, we define training as education programs that seek to impart knowledge of safe construction to households. Better understanding of the construction training methods in shelter projects will enable us explore how construction training may influence knowledge outcomes. Using findings from our first question, we thus ask the question:

RQ2: How does construction training impact household construction knowledge?

We begin by discussing previous literature on construction knowledge and training methods in post-disaster contexts. Using interview and survey data collected following Typhoon Haiyan in the Philippines, we analyzed the types of training methods observed across nineteen shelter projects. Using these findings, we next analyzed the impact of training methods on construction knowledge outcomes.

Background

Training Methods

Past work in the disaster field has focused on the training of first responders (Paton 1994), however there is a dearth of research on post-disaster construction training. Numerous studies have identified training to be important for adoption of improved building practices (Amaratunga and Haigh 2011; Jordan et al. 2015; Lizarralde and Root 2008). While it is understood that there is a positive correlation between training and increased capacity at the community level, the means through which this occurs is not well understood. Specifically, calls in the literature highlight the need to study the *effectiveness* of training programs (Wang et al. 2008).

While training programs are the means through which organizations continue to operationalize knowledge sharing with disaster-affected communities, we lack the ability to compare these differences, in part, because of no standard definition of what is considered 'training.' The term 'training' is often used interchangeably with "information, education, and communication (IEC)," "technical assistance or support," and "guidance." Each of these is often discussed at different scales and each involves a variety of methods that seek to provide access to knowledge on safer building.

In humanitarian response, the cluster system is comprised of thirteen sectors that seek to coordinate organizations. Sectors broadly align with humanitarian practice (e.g. health, nutrition) – in the context of this research – the Shelter Cluster is central as they often develop and distribute guidance on construction training. For example, in the aftermath of Typhoon Hiayan in the Philippines, where this research focuses, the Shelter Cluster developed "8 Key Messages" that outlined key learning outcomes for households and builders to understand and apply.

Experiential Learning Theory

The Kolb Learning Styles Inventory (LSI) provides a means to quantitatively assess how individuals learn from experiences. We use LSI, which was first established in 1969 and has become a mainstream and validated instrument to examine experiential learning theory (Kolb and Kolb 2005), to categorize training methods. The inventory is composed of four discrete learning orientations or poles: (1) concrete experience (CE), (2) reflective observation (RO), (3) abstract conceptualization (AC) and (4) active experimentation (AE). Concrete experiences emphasize personal involvement or connections, relying on feelings rather than logical approaches to the situation. Reflective observation is when a learner relies on their own thoughts to formulate objective and carefully constructed judgements, often through watching. Abstract conceptualization involves logical expressions and systematic planning that links to theoretical perspectives associated with thinking. Active experimentation takes an active form where the learner is immersed and influenced by changing situations and practical application through doing. Much of Kolb's theory has been explored through the lens of learning styles, yet relatively little research has explored methods that may potentially align with the respective poles.

Methods

We used a multi-method approach to address the research questions, investigating training in shelter projects in the Philippines following Typhoon Haiyan. Nineteen communities were selected, each receiving shelter assistance from a non-governmental organization (NGO). For this research, we defined a shelter project as any intervention by an organization external to the community that sought to provide shelter assistance. Examples of this assistance included in-kind assistance (e.g. construction materials), direct-build construction (e.g. contractor built shelter), conditional cash, and training. To answer our first research question of what training methods are used in shelter projects, we used qualitative analysis to analyze the occurrence of various training methods. We then analyzed surveys that assessed construction knowledge and employed ANOVA tests to verify differences in construction knowledge between communities. Finally, using fuzzy-set qualitative comparative analysis (fsQCA) we compared the presence of training methods mapped against Kolb's four learning poles to construction knowledge scores for each of the identified communities.

Data Collection

Two sets of data were used to address the research questions identified; first we collected interview data, observations, and documentation which was used to assess training formats. We then administered a survey to households to assess construction knowledge.

Training Methods

In total, 210 interviews were conducted with households, NGO staff, and government officials over four field visits spanning three years. Organizations were asked to describe any construction training to the communities selected. Examples of interview questions pertinent to training included *'How is training administered?'* and *'What materials do you use to train individuals?'* Follow-up questions were asked during ongoing field visits over the three-year period to assess whether training methods evolved or changed, targeting potential reasons for such modifications. We asked similar questions of community members, including questions that asked them to describe the training they received in order to validate organizational interviews. Example interview questions included, *'Can you describe any training you received?'* and *'What skills or knowledge did you learn?'* A local translator was used to ask questions in the household's native language, either Bisaya or Waray. Households were also asked to compare their new shelter with their home prior to Haiyan. In the event they identified a stronger building practice, they were asked how they acquired this knowledge. This was to account for non-traditional or emergent forms of learning that may not have occurred in formal, organization-led training programs.

Observations included attending eight organization training sessions, five cluster coordination meetings that addressed training strategies, and more than 120 hours of ongoing construction within communities. Field notes included identifying methods that were employed by organizations, such as lectures, and any specific tools that were used during sessions. Other practices observed during construction, such as identifying who was watching or assisting construction activities, were also noted. Documentation collected included material checklists, pre- and post- tests administered by organizations, and cluster posters provided to communities on construction recommendations.

Construction Knowledge

A notable output of Shelter Cluster coordination during the Haiyan response was '8 Key Messages' on safer building. These themes included: (1) foundations, (2) tie-downs, (3) bracing, (4) joints, (5) roofing, (6) site selection, (7) building shape, and (8) preparedness. Standards within each category were provided to organizations providing shelter assistance, resulting in their widespread distribution to communities, either directly through documents that the Shelter Cluster produced or that were adapted and integrated into organizational training efforts. Key message guidance was first distributed in June of 2014, approximately seven months after Haiyan. To assess construction knowledge, we developed a fifteen question survey, which was based on the technical guidance produced by the Shelter Cluster, as this aligned with broad learning outcomes agreed upon by humanitarian organizations.

Questions included six multiple choice answers (select one and select all that apply), six rank order and three true/false. Standards were taken verbatim from Shelter Cluster documentation as we intended to test knowledge that was standardized as best practice across organizations. For example, when asking about tie-downs, four alternatives were listed with a picture and description, and respondents were asked to rank components in order from strongest to weakest. This was then scored based on the distance of ranked items from their correct positions. Each question was weighted equally. The themes of tie-downs, location, slope, preparation, roofing each had one question; foundations, bracing and joints had two questions. Themes with a larger number of questions had more individual recommendations in the original Shelter Cluster guidance or we identified the initial guidance to be more complex than the other themes.

In total, we collected 880 surveys from across the nineteen studied communities. Surveys were provided in written format and provided in the native language of the household, either Bisaya or Waray. A local research assistant administered the surveys so that any questions could be addressed in the participant's native language. Households were selected using a stratified random selection, using puroks (neighborhoods) as the strata. This geographic approach to sampling was selected in the absence of any database to perform true random selection methods. Minimum samples sizes were determined for each community using known populations and expected variance in test score data. A minimum threshold of 20 surveys per community was determined from sample size calculations.

In addition to testing construction knowledge, we also collected data on respondents' gender, education level, age, previous construction experience, English proficiency, and place of birth. Educational levels were assessed as: (a) no formal education; (b) some elementary; (c) elementary graduate; (d) some high school; (e) high school graduate; (f) some college; and (g) college graduate. English proficiency levels were self-assessed by households as: (a) beginner; (b) intermediate; (c) advanced; and (d) fluent. Finally place of birth was categorized as either: (a) within barangay; (b) within municipality; (c) within province; or (d) outside of province.

Analysis

Our analysis consisted of first characterizing the types of training observed, verifying differences in construction knowledge across communities using ANOVA, and then calibrating our data for use in fsQCA to examine casual conditions that led to higher construction knowledge.

Training Methods

To answer our first research question of what types of training methods are used in shelter projects, interviews were translated, transcribed, and then imported into QSR NVivo software for qualitative coding. We adopted a deductive coding structure derived from experiential learning theory in order to classify observed training methods into the four Kolb poles – concrete experience, reflective observation, abstract conceptualization, and active experimentation. These were selected in order to categorize the underlying delivery mechanisms of training, affording more detail and generalizability. For example, one household described training they received on construction techniques as follows, *"We were given photocopies of the picture of the house and a poster was posted in the barangay. There was an illustration of the house plan and the picture of a completed house."* This was coded under reflective observation as households presented these learning modalities focused on the visualization of knowledge in a reflexive manner. Coding definitions and examples are presented in Table 4-1.

Table 4-1: Training Qualitative Coding Structure

Kolb Pole	Coding Definition	Examples
Concrete Experience (CE)	Tangible, felt qualities of the world through immersion of hypothetical situations	Community stories; historical experiences
Reflective Observation (RO)	Passive participation involving listening or visualization	Pictures; lectures
Abstract Conceptualization (AC)	Thinking about, analyzing, or systematically planning, rather than using sensation as a guide	Diagrams; maps
Active Experimentation (AE)	Ability to engage with objects or materials through testing or trial and error	Material demonstration

A second coder independently coded a sample of 42 interviews (two interviews from each community and four cross-cutting interviews) and inter-rater reliability scores, in the form of Cohen's Kappa coefficient, were calculated in order to ensure robust construct validity. Kappa values of 0.4 were used as a threshold for acceptable agreement (Landis and Koch 1977). In the case that any interview did not meet this threshold, both coders revisited coding until consensus could be reached. Using interview codes, in combination with documentation and observations, we developed a typology of construction training methods used across shelter projects.

Linking Training Methods to Construction Knowledge

We first sought to verify that there were differences in construction knowledge across different communities using ANOVA. A significance level of 0.05 was assumed for statistical testing. Each of the individual 15 construction knowledge questions were scored from zero to one and summed for an overall test score for each individual surveyed. Some question types only had zero or one values, such as true/false questions, while others such as rank order, were scored based upon partial correctness. Individual scores were then averaged for each community, resulting in comparable numerical scores of construction knowledge. We found that there were statistical differences leading us to move to our next phase that explored these differences using fsQCA. A discussion of the differences found using ANOVA is discussed below in our findings.

In the second phase of our research, we built on the identified training methods to examine which types of methods were more likely to lead to higher construction knowledge using fsQCA. Qualitative comparative analysis presents a middle ground between qualitative and quantitative methods, leveraging a set-theoretic approach to understand how combinations of conditions, equivalent to independent variables in conventional statistical analysis, in isolation or combination, lead to outcomes, or dependent variables in conventional analysis (Ragin 1987). An outcome of interest is first selected, in this case construction knowledge, and conditions are identified that are posited to influence this outcome. We hypothesized based upon theory that Kolb's four experiential learning poles in construction training would impact the outcome of construction knowledge, building upon our earlier analysis. From our previous qualitative analysis, households commonly discussed obtaining knowledge outside of formal training, thus we sought to include this in our analysis of construction knowledge. In particular, on-site construction observations by households were added in additional to training methods aligning with the four Kolb poles. Further, we also wanted to assess whether if formally structuring training had an impact on knowledge outcomes. Here, we defined 'formal' as whether the organization recognized the methods as constituting training and integrated these efforts into broader shelter programming. For example, if an organization intentionally built a pilot shelter to show concepts resulting in the ability of households to reflectively observe construction, this was considered formal training. Whereas, unplanned observations of neighbor construction would not be considered formal training. This resulted in six conditions being selected for analysis.

Variable Calibrations

The calibration of conditions is an important step in fsQCA as it provides theoretical context to measurement (Ragin 2009). For each of the six conditions identified – training methods (concrete experience, reflective observation, abstract conceptualization, active experimentation), on-site observations, and formal training – we opted to use an indirect method of calibration that relied on qualitative data to structure sets. In contrast, we use a direct method of calibration for our outcome, construction knowledge, as the data was quantitative.

We calibrated our outcome variable, construction knowledge, based on the community average for each shelter project, drawing from survey data collected. After averaging test scores within each project community, we transformed the raw test score data log-odds into fuzzy-set values for each community where projects were located. Anchors points were used to establish theoretical membership in the set; specifically, we set membership as 11 or higher on our construction knowledge test and non-membership as 10 questions answered correctly. While the difference between these two values is small, practically, we observed differences between cases in interviews. A crossover point was selected at 10.5, between the two anchors.

For our training conditions, we drew from Kolb's four learning 'poles' to structure our training conditions that include: (a) concrete experience; (b) reflective observation; (c) abstract conceptualization and; (d) active experimentation. While we could have alternatively selected individual training methods, this would have increased our logic space by growing the number of conditions considered, whereas Kolb's four poles provide greater parsimony toward underlying characteristics of training methods. For each of the four conditions corresponding to each respective pole, we opted to use a crisp set that was defined on the presence or absence of content in that given area. For example, if a shelter project was previously coded as including reflective observation in the training methods observed, this case was assigned a set score of 1. In order for a case to be scored as having membership in a given learning pole, there had to be consistent mention across interviews for that given case. Methods within each of the four Kolb poles were evaluated and scored based on the presence or absence of training formats in each respective area.

We calibrated on-site observations similar to the previous training methods, using a crisp set. Where households could observe construction, a set score of 1 was assigned, whereas the absence of this was assigned a value of 0. A common example of not being able to observe construction was through relocation or direct-build shelter projects. Our earlier calibration of training methods, did not explicitly include whether these methods were formal, or delivered through the implementing organization. As such, we also included a condition of whether the training was delivered through a formal training program associated with the shelter project.

Pathway Analysis

After assigning membership for each condition to the project cases, we compiled our truth table used for analysis of casual pathways. In total six conditions were selected for analysis. The final truth table is shown below in Table 4-2. Our truth table was then imported into fsQCA software for analysis (Ragin et al. 2008). Pathways were assessed using consistency and coverage measures. Consistency measures the degree to which cases with a given set of factors or conditions exhibit the outcome, where a consistency score of 0.8 is required and coverage measures the degree to which a given pathway explains the cases analyzed, indicating the relevancy of each pathway (Rihoux and Ragin 2009). During this analysis, we also determined which individual conditions were *necessary* or *sufficient* to produce the outcome, where necessity is a measure of the degree to which the outcome is a subset of the causal condition and sufficiency provides a measure of the degree to which the causal condition is a subset of the outcome.

Table 4-2: Training Truth Table

Case	Community	CE	RO	AC	AE	Observations	Formal Training	Construction Knowledge
1	Okoy	1	1	1	1	0	1	0.56
2	Maricaban	1	1	0	1	1	0	0.94
3	Poblacion	1	1	0	1	0	0	0.34
4	Sungko	1	1	0	1	1	1	0.99
5	Sillon	0	0	0	0	0	0	0.07
6	Kangkaibe	1	1	0	1	1	0	0.98
7	Tagpuro	0	0	0	0	0	0	0.17
8	Pago	1	1	1	1	0	1	0.53
9	New Kawayan (101)	0	1	1	0	0	1	0.03
10	Bagacay (93)	1	1	1	1	1	1	0.88
11	San Agustin	1	1	0	1	1	1	1.00
12	San Jose (83C)	0	1	0	0	1	0	0.86
13	Magallanes (52)	1	1	1	1	0	1	0.09
14	San Jose (85)	1	1	1	1	1	1	0.9
15	Hiabangan	1	1	0	1	0	1	0.94
16	Sagkahan (62)	0	1	1	0	0	1	0.41
17	Sulangan	1	1	1	1	1	1	0.17
18	Cogon	0	0	0	0	0	0	0.59
19	Cantahay	1	1	1	1	1	1	0.89

Findings

To answer our research question of what factors account for differences in household construction knowledge, three sections are presented below. The first outlines a typology of training types that emerged from the context of the Philippines. We then present a summary of construction knowledge test scores by community. Finally, we discuss casual pathways that led to higher construction knowledge.

Training Methods

Of the nineteen communities studied, seven lacked any formal construction training programs. To reiterate, we considered any direct method of sharing knowledge between an organization and a household as formal training. Of the shelter programs that employed training, a typology of training formats emerged from our analysis. Of those projects that employed formal training, we found that six formal methods of providing construction training were used by organizations. More than one method of training could, and often did, appear in a single project. For example, it was common for organizations to organize a lecture, while also distributing posters with key messages in a community. In order of frequency of use, these included: (1) diagrams, (2) lectures, (3) demonstrations, (4) hand-out materials, (5) posters, and (6) photos. Frequencies of use are presented in Table 4-3.

Table 4-3: Training Methods Applied

Kolb Poles	Training Method	Frequency of Use
AC	Diagrams	75%
RO	Lecture	58%
AE	Demonstration	58%
RO	Hand-outs	50%
RO	Posters	25%
RO	Photos	25%

N=12

RO – Reflective Observation; AC – Abstract Conceptualization;
AE – Active Experimentation

Diagrams were the most widely used method to provide training to households and consisted of housing blueprints or construction details drawn using 2-D plans. For several organizations observed, this was the only means used to transfer knowledge to households on safer building practice. Lectures and demonstrations were the next most used training methods. These were commonly paired together in single day seminars, as one NGO staff member described, *"So the morning was a lecture and then in the afternoon we actually built the little model house."* Lectures ranged in size from 20 individuals to more than 100 individuals in size and proved one of the simplest means of rapidly conveying information to larger audiences. Demonstrations afforded the ability to test component and concepts and frequently made use of model shelters or scaled components. Hand-out materials, such booklets and flyers, were common in about half of programs providing training; however, interviews suggest that these were infrequently read by households. Posters and photos were the least observed methods of transferring knowledge.

In contrast to formal training, two other formats of learning emerged from our analysis. A number of shelter programs either required or recommended that households participate in the construction of their own shelter. This involvement was found to be a source of learning for many households, who, in some cases, took on construction tasks for the first time. Working alongside skilled laborers, lessons on safer building were often transferred from hired labor to households. One female household member described her husband's involvement in assisting with their shelter construction, *"No, they didn't really train him. They did not specifically teach us how things should be done. He just learned from them somehow, picked up a few ideas by assisting them during the construction."* In addition to household participation in construction, the second method of household learning that surfaced was watching construction, either on their own house or their neighbors'. Even in the absence of formal training methods, the observation of construction provided a means to examine and learn new construction methods, such as strapping and bracing.

Difference in Community Construction Knowledge

The average score on the construction knowledge test was found to be 10.62 (out of a possible 15) with a standard deviation of 1.59. This suggests that, on average, households answered questions correctly for about two-thirds of concepts targeted by recognized standards. We found that there were statistically significant differences in construction knowledge between communities ($F=3.293$, $p<0.01$). A comparison of construction knowledge test score boxplots is shown below in Figure 4-1. This plot suggests that there are community-level factors that influence construction knowledge (e.g. training methods) and variation within communities suggests that there are also individual level attributes that influence construction knowledge.

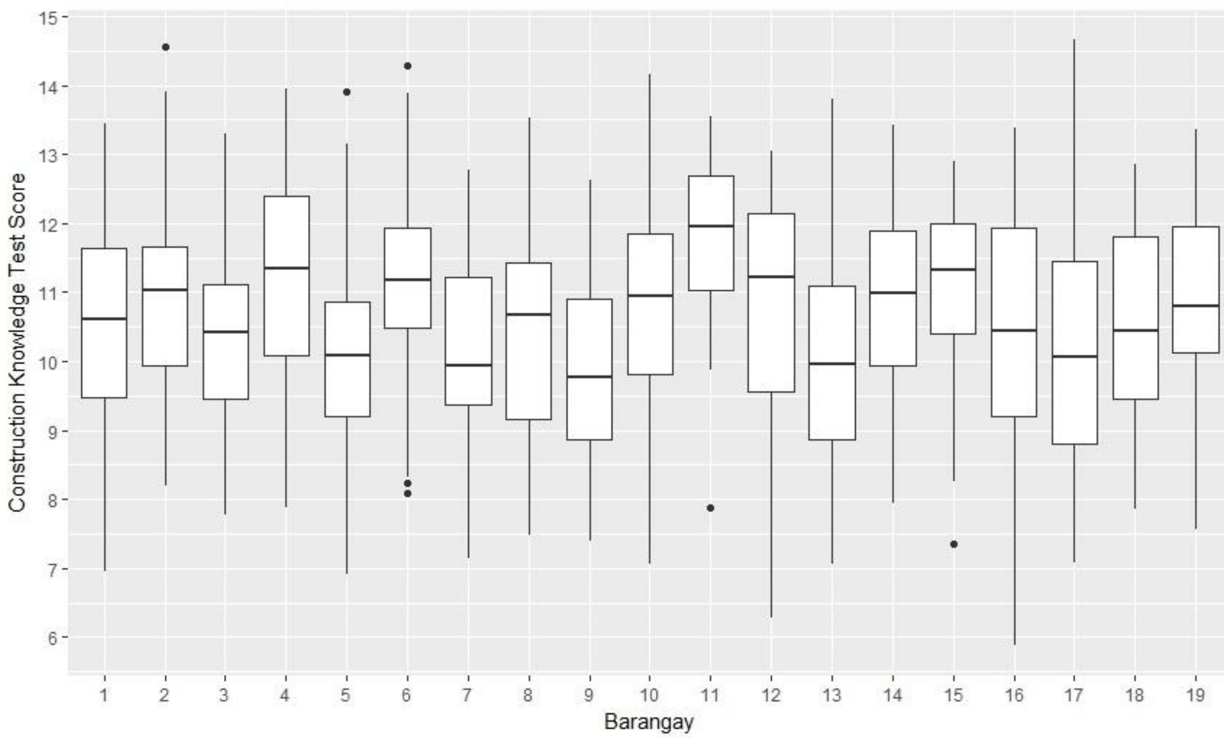

Figure 4-1: Construction Knowledge Scores by Community[1]

In total, 53% of respondents were female and 47% were male, approximating population gender demographics of the selected communities. The average respondent age was 38 with a standard deviation of 14 years. Across demographic attributes, we found that respondents with differing education levels had significant differences in construction knowledge ($F=4.896$, $P<0.01$). We did not find differences in construction knowledge among different genders, levels of English proficiency, ages, or previous construction experience (either before or after the typhoon).

While many organizations emphasize the importance of transferring knowledge on safer building principles to households, implementing agencies typically assumed that this had to occur through direct and intentional learning activities or materials. In our preliminary analysis of construction

[1] The median test scores are noted by the middle bar; the first and third quartiles are denoted by the top and bottom of the boxes, respectively; and the whiskers end at either the minimum or maximum values. In the event any outliers were present, the whiskers terminate at 1.5 times the inter-quartile range (IQR).

knowledge across projects, t-test results showed a statistically significant difference between communities where households were present during construction and communities where households were not present during construction to observe construction methods and ask questions. We found that the households within communities that included on-site observation had an average construction knowledge score of 10.88, and those without on-site observations had an average construction knowledge score of 10.36; ($t(877)=-4.99$, $p<0.01$). This suggests observation during construction plays an important role in learning.

Our interview data from households supported these findings and suggest that, in addition to intentional training activates, households acquired new knowledge through observation of new construction techniques applied. As such, we included on-site observations as a condition of interest in our analysis. To calibrate this condition, we defined membership as presence of the household during construction, where households had the ability to observe new techniques being used and ask questions to carpenters and masons. In contrast, out of set membership as lacking presence of the household during construction. This was most common for relocation programs where households did not witness construction and moved after completion of the shelters.

Pathways to Construction Knowledge

Our analysis of casual conditions showed two pathways that led to the presence of construction knowledge. Our solution had an overall consistency of 0.95 and a coverage of 0.5. A summary of the two pathways identified can be found in Figure 4-2. Reflective observation training methods were found to be a necessary condition with a necessity value of 0.93. This suggests that households required at least some passive education formats in order to internalize knowledge. For the other six cases that had high household construction knowledge but were not covered by the two pathways identified, five of the six cases included formal training that covered all four types of training methods differing from the first pathway found by the presence of abstract conceptualization training methods.

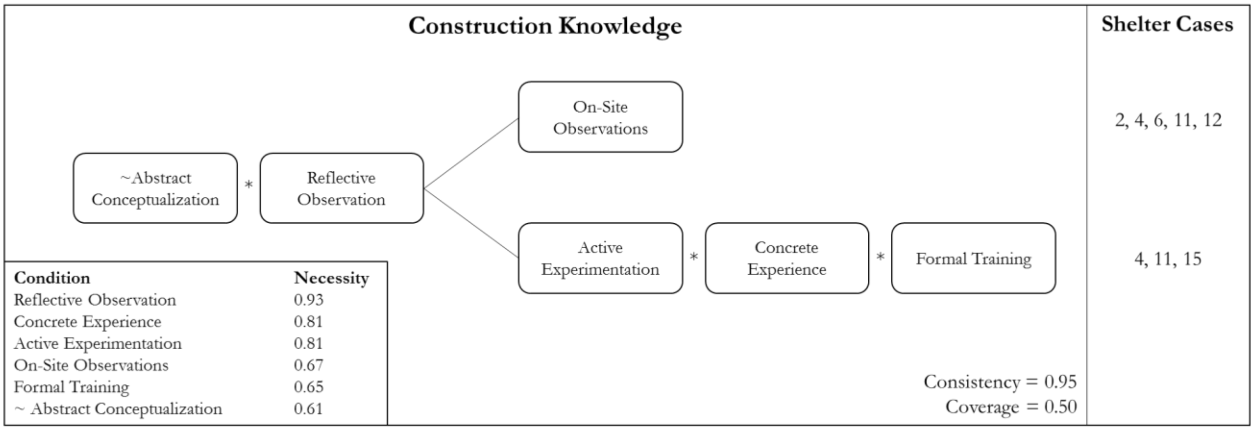

Figure 4-2: Pathways to Construction Knowledge

The first pathway covered five of the twelve cases that showed the presence of construction knowledge and included the absence of abstract conceptualization training methods, the presence of reflective observation methods, and on-site observations by households during construction. For all of the cases that fell into the first pathway, skilled labor was employed by the implementing organization and all the projects were in-situ, allowing households to observe construction of their neighbor's shelters. The importance of observations in this pathway was demonstrated by one individual, *"First, I was able to watch the group that built the bigger houses, and I learned a lot of techniques from the builders. So, when it was time for our house, smaller compared to the first, I was vocal in airing my observation based on my previous experience. Every now and then I make suggestions on how to construct a specific portion. One time I called them out when I saw that they didn't install the posts properly because I've seen how it was seamlessly set up by the builders from the bigger house."* We saw that this inclusion of reflective observation acted as a catalyst for households to internalize knowledge. Further, the connection of these observations through established social ties build trust in the knowledge being acquired.

The second pathway covered three cases and included the absence of abstract conceptualization methods and reflective observation methods, similar to the first pathway, but also included active experimentation methods and concrete experience methods. This pathway was also unique from the first in that the cases showed the presence of formal training. In contrast to the first pathway, which relied on information, education, and communication (IEC) materials, projects in this pathway had formal workshops. Further, all of the projects in this pathway were material distributions, which supplied a core set of building supplies such as posts, sheets of plywood, and framing members to homeowners, in combination with technical support.

In interpreting our pathway results, the most obvious distinction that emerged was that the first pathway relied on observation as a means of learning, while the second relied on formal training that drew from multiple methods. There has been a traditional focus on formal training, but our results show that more cases that achieve construction knowledge actually do so through passive means. While we hypothesize that this may in part be due to cultural differences in learning, in particular a high power distance between the role of educators and learners (Hofstede 2003), it none the less reinforces the important role of demonstrations, lectures, photographs, and other methods that allow for reflective observation of building concepts.

Additionally, an intriguing finding was that the absence of abstract conceptualization methods was central to both pathways. This pole aligned with the use of maps and technical diagrams; many households expressed difficulty understanding these and were unable to visualize two dimensional representations and architectural plans. The absence of abstract conceptualization in the pathway reinforces that the presentation of overly detailed information was detrimental to household acquisition of concepts.

Discussion

In exploring construction knowledge after Haiyan, several cross-cutting themes emerged from our analysis and findings. Fundamentally, all training programs emphasized a reliance on principles, rather than standards. An emphasis on principles aimed to transfer knowledge that could be readily accessible by individuals. There is important distinction from other types of professional training that seek to transfer process oriented knowledge. In other words, the knowledge required for households did not require them to build a shelter themselves, but rather recognize deficient construction. This was summarized by an NGO staff member:

> "It is all about capacity building. If you just build people's houses and leave, the next time a storm happens you have to come back because they don't know how to do logistics, they don't know how to do it properly, they don't know how to design a house, but if you teach people, and again this is the difference I think between my philosophy and the Filipino philosophy, I don't teach standards, I teach principles. The difference being the standards is like down to the point, has to be four millimeter GI [galvanized iron sheets], has to be this, has to be that, really nitty gritty, so my philosophy and all of our philosophy is when we leave we never have to come back – people have the skills and knowledge. Now that isn't a six-month commitment that is a three to five, to seven-year commitment like we started with a three-year commitment, most people start with a three year, we were speaking to people in Haiti most of them made three or five and lasted seven."

Our construction knowledge test results showed that, on average, individuals were able to demonstrate proficiency in recognizing about two-thirds of the messages targeted by shelter organizations. This final number is higher than earlier monitoring conducted by organizations involved in this research. In surveys during construction by an organization in one of the higher performing communities, an NGO staff members noted the following, *"Unfortunately, our data is saying that only 27% of the people remember any five of the eight key messages. Our target is about 90% to remember."* While we lacked pre-training data on construction knowledge, qualitative evidence suggests that overall construction knowledge of households improved during recovery. Formal training programs resulted in the presence of high construction knowledge of households, but our findings suggest that those learning through informal methods may actually gain equal proficiency of safer building principles.

As repeatedly noted by NGO staff, structured training was time and resources intensive. We saw that a minimum threshold of resources needed to be allocated to training in order to realize the benefits. A training advisor to the Shelter Cluster expressed this theme:

> "If you want to make effective learning in training, you have to get people participating in your learning process. That is time intensive, that is cost intensive, that is human resource intensive and that is something which isn't there. Unfortunately, what is happening is that you have got road shows where you have got 80 people sitting there in a Barangay [community], 30 degrees with humidity in the middle of the day, and you've got one big 'build back safer' banner out there and somebody talking and nobody beyond the second row is listening to what is going on."

Thus, while training is widely recognized as an important part of reconstruction programs, in many cases, the implementation of training programs is treated as something that is necessary to do, which can be 'checked off', without focusing on the process and long term learning gained from the program. As our findings suggest, formal training does not require targeting all households, thus organizations should focus their resources on ensuring that training is well structured and provides an adequate diversity of methods. Further, as well-developed construction craft worker apprentice programs in developed countries demonstrate, the use of formal and informal training methods need not be exclusive of each other. While organizations may view training as a costly endeavor, our findings point to the potential to leverage multiple types of methods. Such an approach obviously comes with challenges, such as the ability to monitor and evaluate learning through informal methods such as observation, but also comes with greater scalability.

Limitations

There are several limitations of study that merit attention. Notably, we did not have the ability to provide a pre-test before training programs as we were unable to identify participants prior to their training. As a result, we were unable to measure changes in construction knowledge directly. Such data, while difficult to collect, should be attempted in future research to more fully explore changes in construction knowledge. However, through extensive qualitative data, which asked trained and un-trained individuals about their experience and construction knowledge, we also triangulated data sources to validate our findings. Further, select communities may have inherently possessed a stronger grasp of the tested construction principles. We attempted to mitigate this by covering a relatively large number of communities and diversity of training programs.

We also examined training methods at the community level, rather than individual level, and we acknowledge that some individuals may not have received the methods used by organizations within their community. While an individual unit of analysis would have afforded greater comparison of formal training methods, it would have neglected the ability to capture informal knowledge acquisition outside of documented training due to sampling of only trained individuals. Further, we found that individuals had difficulty identifying what constituted participation in a training during self-reporting We encouraged individuals to report any significant activities they felt contribute to their learning, but relied on accurate participant recollection. Further, we did not have a measure for explicitly addressing the quality of training afforded and quantifying differences in the same type of method between two organizations; future work should seek to develop tools to compare quality across similar methods. We did, however, rely on the Shelter Cluster '8 Key Messages' standardized content and we attempted to mitigate any impacts of differing quality by selecting a relatively large number of case communities.

Lastly, in assessing knowledge of safer construction, we relied upon the '8 Key Messages' as a reference to define learning outcomes. While the quantitative scores have a relatively small margin of difference – a variation of approximately 10% of the total possible score – altering our cutoff for possessing safe construction knowledge could have resulted in differing findings. Because defining what constitutes sufficient knowledge is a grey area, future work is needed to connect life-safety standards in building to adequate knowledge levels.

Future Work

Our research has taken the first step to operationalize construction training in humanitarian shelter programs. This is a ripe and needed areas of research, and future work is needed to continue expanding our understanding of training methods and learning outcomes. While we characterized the training methods that were used in one disaster context, future research should continue exploring to how humanitarian organizations provide training – other types of disasters, such as earthquakes and floods, as well as conflicts should also be examined. We have investigated training through the lens of experiential learning theory, but the application of other education theories can aid in explaining appropriate formats to convey safer construction knowledge. There has also been much debate about whether or not learning styles, such as those proposed in Kolb's theory of experiential learning, are valid and can explain differences in skill and knowledge acquisition. The testing of such theories in practical contexts, such as following disasters, could provide additional evidence to advance understanding of these educational theories. Finally, our study has shown that methods of training play a role in the acquisition of construction knowledge. Households understanding this knowledge is imperative, but only the first step in understanding how and why some households chose to employ this knowledge and others do not. Future research should continue to explore the drivers of adoption of safe construction, both in formal shelter assistance programs and by households that do not receive assistance.

Conclusion

While there are growing calls that point to the importance of training in post-disaster recovery (Ginige and Amaratunga 2011; Jordan et al. 2016), there is a dearth of research that has sought to categorize and operationalize what constitutes construction training in post-disaster shelter. Further, there is a significant gap in understanding how training leads to the acquisition of construction knowledge. In this research, we analyzed training programs administered as part of shelter projects in nineteen communities within the Philippines following Typhoon Haiyan. We first identified training formats, and then categorized types of training methods using Kolb's experiential learning theory poles. Next, we used Kolb's learning poles, along with formal training and on-site observations, to analyze how households acquired construction knowledge using fsQCA.

There is a telling gap that surfaced between how training was delivered and how households acquire construction knowledge. While reflective observational methods were required in both pathways discovered to construction knowledge, there was significantly fewer methods that drew upon concrete experiences, despite the latter's presence in leading to construction knowledge. In 75% of projects, abstract conceptualization poles were touched upon through maps and other technical diagrams, however the absence of this pole was found in both pathways to higher construction knowledge. The absence of this abstract conceptualization challenges previous experiential learning theory (Kolb 1984), which suggest that all four poles are necessary. Our findings expand experiential learning to a new domain, disaster recovery, and provides new insights into the specific experiences that ground learning of construction knowledge.

Our findings also point to several practical contributions for organizations. Foremost is the need to leverage on-site observations of construction activities. The most successful example of how this was operationalized into programming was through pilot shelters. By allowing households to visually examine shelters prior to construction of their own, organizations can provide an opportunity to instill the needed skills to assess whether safe construction techniques are applied. If on-site observations cannot be used, such as in the case of relocation projects, there is need to invest sufficient resources and time in formal training programs that use a set of diverse methods. Complementing our findings focused on training methods, we also found differences in construction knowledge between different individual education levels. More broadly, higher construction knowledge among higher education groups suggests that long-term investments in education may lead to a population that is capable and skilled in building infrastructure.

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CHAPTER 5 A COMPARATIVE ANALYSIS OF COORDINATION, PARTICIPATION, AND TRAINING IN POST-DISASTER SHELTER PROJECTS

Abstract

The delivery of post-disaster shelter assistance continues to be fraught with challenges derived from the coordination of resources, involvement of project stakeholders, and education of households and builders. While recent literature has started to explore post-disaster shelter from a management perspective, there remain gaps in understanding what project elements are most crucial to the delivery of post-disaster shelter projects. Examining nineteen post-disaster shelter projects in the Philippines following Typhoon Haiyan, we employed fuzzy-set qualitative comparative analysis (fsQCA) to operationalize coordination, participation, and training across the planning, design, and construction phases of projects and assess their impact on building resilient and sustainable community infrastructure systems. Findings show that early involvement of households in planning efforts, combined with subsequent training, was important to build local capacity and situate recovery efforts within local priorities. Recommendations point to the need to: (1) promote shelter processes over products; (2) integrate construction training into shelter projects, (3) link support to long-term recovery efforts.

Keywords: resilience, sustainability, fuzzy-set qualitative comparative analysis, disasters, shelter

Introduction

Disaster events continue to affect millions of people annually (Guha-Sapir et al. 2015) and are particularly devastating in developing countries, where the effects are amplified up to twenty times that of industrial nations (World Bank 2006). Post-disaster, there is a pressing need to reconstruct infrastructure systems rapidly with limited funds from a diverse group of agencies and organizations. Despite significant advancements in post-disaster response and recovery over the last several decades, shelter after disasters remains one of the most complex and difficult tasks due to its socio-technical nature and unique, localized implementation. While project management literature has developed theory across the planning, design, and construction phases, these segmented tasks have yet to proliferate in post-disaster research of shelter. In the context of these phases, recent literature has highlighted the importance of three particular processes that include coordination (Drabek 2007; Ritchie and Tierney 2011), participation (Barenstein 2009; Davidson et al. 2007), and training (Amaratunga and Haigh 2011; Jordan et al. 2015).

To reconstruct shelter that will function over time, communities must mobilize and coordinate resources from government agencies and organizations. Following a disaster, a unified approach to shelter is often absent (Stephenson Jr 2005) and cohesive linkages between temporary shelter and permanent housing are sparse. This in turn often leaves shelters unoccupied or in disrepair. Past work in India found that even when permanent housing was constructed, a lack of coordination between NGOs constructing shelter in communities led to different housing structures and resources provided to different members of communities, which in turn contributed to non-integrated infrastructure systems, social tensions, and community unrest (Jordan and Javernick-Will 2013b).

Previous research has also emphasized the importance of stakeholder participation (Davidson et al. 2007; Lizarralde and Massyn 2008) in shelter projects. Participation of households has been shown to lead to higher satisfaction (see Chapter 3), social recovery (Jordan et al. 2016), and has been found in some cases to counteract social vulnerability (Jordan 2013). With the need for safer, more resilient shelter that continues to be maintained and used over time, training is also paramount in shelter projects. A growing body of research points to the need to include capacity building in humanitarian projects in order to ensure that local stakeholders have the skills needed to maintain infrastructure or rebuild after future disasters (Ginige and Amaratunga 2011).

While coordination, participation, and training have anecdotally been found to be important in recovery, little research has formally operationalized these processes to understand how, and when, they impact project outcomes. As a result, this research seeks to analyze what coordination, participation, and training processes are implemented in the delivery of post-disaster shelter construction, and how these processes influence resilient and sustainable infrastructure systems in post-disaster environments. Specifically, this research will identify the *processes* employed across various rebuilding phases, including *planning, design, and construction*. We will map these processes throughout rebuilding phases, and compare and contrast these processes across multiple community projects to analyze *how* different processes, combined or in isolation, influence the resilience and sustainability of built infrastructure. Thus, we seek to address the following research question:

RQ: What combinations of coordination, participation, and training in shelter project phases lead to sustainable and resilient infrastructure systems?

We will first review literature on resilience and sustainability infrastructure outcomes, making the case for why there is a need to differentiate between these constructs, and briefly review the impact of coordination, participation, and training on these outcomes. Next, we describe the methods employed to operationalize and analyze these project processes in each phase of planning, design, and construction, as well as the methods used to analyze the impact of these processes on infrastructure resilience and sustainability outcomes within nineteen humanitarian shelter projects in the Philippines following Typhoon Haiyan. Finally, we discuss implications of our findings and conclude with recommendations for practice and theory.

Background

We first review two prevalent post-disaster outcomes – resilience and sustainability of community infrastructure systems – before a brief discussion of three conditions – coordination, participation, and training – posited to impact these outcomes. While our posited conditions focus on shelter project processes, the overall focus is on how these processes affect broader community infrastructure systems, not solely housing itself.

Resilience

Definitions of hazard resilience are diverse, yet disaster literature converges on two points: resilience is best conceptualized as a set of abilities or capacities, and it is better explained as adaptability over stability (Norris et al. 2008). In particular, we note that resilience is not static; it continues to change over time. In measuring this outcome, the current state of indicators captures capacities at a single point in time and draws assumptions for how infrastructure, social, and economic systems will respond in the face of a future disaster. This research builds upon previous work that recognizes that recovery trajectories after a disaster event are not linear, thus we will focus on the predicted state of community systems after a disaster, not on the speed at which this restoration might occur when defining resilience.

Past work has extensively studied the role of social capacities in resilience at the community level (Aldrich 2012; Cutter et al. 2008); however, less is known about how societal mechanisms support (or deter) infrastructure resilience. Physical models of resilience have also been well studied (e.g., Vugrin et al. 2010) but these efforts focus almost exclusively on the design phase, neglecting the role that the construction phase plays in ensuring system resilience. There are, however, increasing efforts to link social and physical dimensions to consider infrastructure as socio-technical systems (Holnagel 2014).

Drawing from a systematic review of resilience literature (Opdyke et al. 2017), we created a multi-level assessment of infrastructure resilience based on four dimensions: (1) infrastructure, (2) governance, (3) economic, and (4) social. While the focus of our study was on community infrastructure system resilience, we include these three other dimensions due to their interconnectedness in supporting infrastructure in disasters. In total, we collected and analyzed data on 15 sub-outcomes across the four dimensions, shown below in Table 5-1. A more thorough discussion of criteria used for the inclusion of these sub-components can be found in Appendix E.

Table 5-1: Summary of Resilience Outcomes

Infrastructure		**Governance**	
[R1]	Housing	[R9]	Disaster Management Planning
a.	Housing Design	[R10]	Regional Cooperation
b.	Housing Construction Quality	**Economic**	
[R2]	Water Access	[R11]	Household Savings
[R3]	Sanitation Access	[R12]	Employment
[R4]	Electrical Access	**Social**	
[R5]	Education Access	[R13]	Social Capital
[R6]	Medical Care Access	[R14]	Native to Community
[R7]	Transportation	[R15]	Community Organizations and Mobilization
[R8]	Evacuation Centers		

Sustainability

The second outcome of this study, sustainability of community infrastructure, possesses a range of connotations, often tailored to specific sectors. Definitions, however, commonly focus on three aspects of sustainability – economic, social, and environmental – with a growing number of indicators for each area of construction projects in developing countries (e.g. Ugwu and Haupt 2007). Recent literature emphasizes the importance of the last component, social sustainability, in both the design and construction phases (Valdes-Vasquez and Klotz 2013). In the context of this research, we define sustainability as capacities that promote continued use and functionality of infrastructure. We included six sub-outcomes from literature (Ugwu and Haupt 2007), shown in Table 5-2, to assess the long-term functionality of community infrastructure.

Household wealth was selected for its prediction of income to support maintenance of infrastructure assets. Service interruptions assessed the frequency of disruptions to systems, and thus measure the ongoing functionality of services, such as water and electricity. Socially, we included land tenure as it indicates whether households are tied to place, which has been shown to be important in past research

(Cutter et al. 2008). Shelter satisfaction has broadly been used in past research as an indicator of the functionality of shelter in meeting household needs and services (Rand et al. 2011; Snarr and Brown 1980) – in this research we compared satisfaction with pre-disaster shelter. For the environmental dimension of sustainability, our indicators focus on the presence of a sanitation system to contain wastewater, which poses a significant health risk. The availability and sourcing of building materials is also included, appearing in significant past literature on sustainability (Shen et al. 2011). Additional discussion of the rationale for selecting these specific indicators can be found in Appendix E.

Table 5-2: Summary of Sustainability Outcomes

Economic	Social	Environmental
[S1] Household Wealth	[S3] Land Tenure	[S5] Sanitation System
[S2] Service Interruptions	[S4] Shelter Satisfaction	[S6] Building Material Sourcing

We approach our understanding of resilience and sustainability as two unique outcomes, but will also analyze a third outcome, which encompasses both sustainability and resilience together. For example, consider a water system that has a central governing body that collects usage fees and has a track record of excellent maintenance. In addition to other characteristics, we might consider this system sustainable. This same system may lack resilience if procedures are not in place to keep the governing body operating in times of crisis should key organizational staff be displaced or unable to work following a disaster. Therefore, while sustainability and resilience may encompass the same system components, each is comprised of differing qualities. Operationalizing each outcome uniquely, and then in combination, provides insight as to the processes needed over time to obtain these coveted goals.

Project Factors Influencing Infrastructure Resilience and Sustainability

Previous literature points us to three factors that arise during the planning, design, and construction of shelter projects that have potential to influence infrastructure outcomes. These include coordination of resource, participation of project stakeholders, and training of households.

Coordination

Previous research has highlighted that poor coordination in large-scale disasters, such as the 2010 Haiti earthquake, can result in deficiencies in recovery service provision (Ritchie and Tierney 2011). The need to align and coordinate organizations when a disaster or crisis occurs is obvious; independent actions of one organization without consideration of the impact on other sectors can have severe negative consequences. Researchers have documented that coordination improves the recovery process (Chen et al. 2008), but, not how coordination occurs across phases of the reconstruction process (Stephenson Jr 2005), nor how different types of coordination in different phases of reconstruction impact infrastructure outcomes. Addressing these gaps in literature, there is a need to unpack and analyze coordination that occurs within the planning and design phases shelter projects in order to quantify the impact of organizational alignment

Participation

The importance of participation of local actors in reconstruction has long been considered an important element of successful reconstruction projects (UNDRO 1982). There is, however, a lack of consensus on what is meant by 'participation,' and there have been calls to operationalize and bring clarity to participation within post-disaster projects (Davidson et al. 2007). Past frameworks have sought to understand participation as a graduated scale, such as Arnstein's (1969) "ladder of citizen participation", which was later expanded by Choguill (1996). However, while literature has consistently documented early participation well (Hayward et al. 2004; Mohanty 2004; Oakley 1991), the impact of participation during later stages has remained disconnected from recovery outcomes.

Traditionally, participation is viewed as community members having a 'voice' in decision-making (Williams 2004). This view of participation focuses solely on political governance, neglecting a resource-focused perspective, which focuses on stakeholder contributions. This can become particularly important when considering multiple entities' goals, such as donor requirements, and their eventual effect on project performance (Chang et al. 2011). Trends for participatory methods now commonly use ‘participation’ as a means to incorporate ‘local knowledge’ in the implementation of solutions, viewing local knowledge as a tangible object that can be extracted (Mosse 2001). This approach lacks consideration that ‘people’s knowledge’ is actually formed through the planning *process*. To address these gaps, there is a need to operationalize the types of participation that occur in post-disaster infrastructure projects, attending to participation in different phases, to understand the types of participation that influence sustainable and resilient infrastructure outcomes.

Training

There has been increasing attention to involve multiple stakeholders in post-disaster reconstruction processes; however, it is important for these parties to possess fundamental skills in the tasks they are performing. Reconstruction often involves the incorporation of new building techniques that aim to reduce pre-disaster vulnerabilities, requiring governments, designers, construction workers, and community members to acquire new knowledge. This is not an easy task considering the range of educational and socio-economic backgrounds of these parties. The training of the former of these, design and construction professionals, has been well studied, and knowledge management frameworks for these individuals have been proposed (Amaratunga and Haigh 2011). The later, community members, lacks the attention received by other stakeholders and requires further study to understand its role in broader recovery outcomes (Ginige and Amaratunga 2011). Training is a critical step in transferring knowledge to stakeholders, not only in participatory processes of design and construction, but also to build capacity to enable community members and local governments to operate and maintain infrastructure systems in a self-sufficient manner. Broadly, the sparse study of training requires further exploration across projects to assess its benefits.

Methods

To analyze coordination, participation, and training in the planning, design, and construction phases of post-disaster shelter projects, we employed fuzzy set qualitative comparative analysis (fsQCA), which has a growing presence in disaster scholarship (Binder 2015; Jordan et al. 2014; Jordan and Javernick-Will 2013b; Marín et al. 2015). fsQCA provides a middle ground between in-depth case studies and statistical analysis; bridging the method divide by drawing upon set theory and fuzzy logic (Ragin 2000). Notably, the method retains complexity within cases in analysis, offering the ability to generalize findings through robust comparisons (Ragin 1987). In fsQCA, an outcome of interest is first identified, such as resilience of community infrastructure systems, then "conditions" are identified that are posited to influence the outcome, such as coordination. Outcomes are roughly equivalent to dependent variables and conditions similar to independent variables in statistical analysis; however, QCA retains unique methodological terminology and the two should not be conflated. Statistical methods rely on correlational measures, while QCA relies on a set-theoretic approach.

We analyzed reconstruction processes longitudinally within communities affected by Typhoon Haiyan in the Philippines. We will first provide an overview of the context before summarizing the data collected and analyzed to address the research question of how coordination, participation, and training impact infrastructure resilience and sustainability outcomes.

Research Context

Typhoon Haiyan made landfall in the central Philippines in November 2013, damaging or destroying over 1.1 million homes and affecting more than 16 million people (Shelter Cluster 2014d). The storm sustained wind speeds of 315 kph (196 mph) and gusts of up to 380 kph (235 mph), making it the strongest storm to ever make landfall (Evans 2014). The disaster presents a compelling case to study, in part, because of the wide variation in approaches taken to deliver shelter assistance to households, providing an opportunity to comparatively examine project elements and assess their impact on recovery outcomes. Nineteen shelter reconstruction projects across three regions in the central Philippines following Haiyan were selected for in-depth, longitudinal investigation after careful consultation with organizations involved in the onset of the response.

Specifically, we sought to select communities of comparable size that displayed variation in reconstruction strategies employed by organizations so as to 'theoretically sample' the three proposed conditions – coordination, participation, and training (Eisenhardt and Graebner 2007; Flyvbjerg 2006). We selected an embedded unit of analysis of a project within a community, and bounded our study at the barangay level – the lowest political division in the Philippines. The communities represented larger cases, whose stakeholders include government officials, non-government organizations (NGOs), and households receiving shelter assistance. Those involved in supplying funding, expertise, resources, or maintenance of the constructed shelter and broader infrastructure represented the bounded system of the case (Creswell and Poth 2017; Stake 1995).

A list of the communities selected and shelter assistance details are provided in Table 5-3. We categorized the type of shelter assistance provided within each community into six modalities that included: (1) repair and retrofit, (2) transitional shelter, (3) core/progressive shelter, (4) rental subsidies, (5) hosting support, and (6) resettlement. Repair and retrofit assistance upgraded and strengthened damaged shelters. Transitional shelter assistance provided interim shelter on the path toward permanent housing. Similarly, core shelters sought a similar aim, but accomplished this through a single room structure that could be expanded without needing to potentially move households to a new site. Rental subsidies and hosting support both provided cash assistance to aid households in seeking rental units or support for shared shelter with family hosts. Finally, resettlement involved permanent reconstruction on new sites away from coastal hazards.

Table 5-3: Project and Community Overview

Case	Community	Municipality	Province	Population	Households assisted	Shelter categories
1	Okoy	Santa Fe	Cebu	3,532	230	3
2	Maricaban	Santa Fe	Cebu	2,999	118	6
3	Poblacion	Santa Fe	Cebu	2,345	40	3, 6
4	Sungko	Bantayan	Cebu	3,296	183	1, 2
5	Sillon	Bantayan	Cebu	4,064	75	3
6	Kangkaibe	Bantayan	Cebu	2,635	348	3, 6
7	Tagpuro	Tacloban City	Leyte	677	86	2
8	Pago	Tanauan	Leyte	917	365	6
9	New Kawayan (101)	Tacloban City	Leyte	543	148	1
10	Bagacay (93)	Tacloban City	Leyte	3,936	150	3
11	San Agustin	Jaro	Leyte	824	45	3
12	San Jose (83C)	Tacloban City	Leyte	2,548	42	3
13	Magallanes (52)	Tacloban City	Leyte	1,304	199	1, 2, 3, 4, 5
14	San Jose (85)	Tacloban City	Leyte	1,572	234	1
15	Hiabangan	Dagami	Leyte	958	165	1, 3
16	Sagkahan (62)	Tacloban	Leyte	1,434	484	1, 3, 4, 5
17	Sulangan	Guiuan	Eastern Samar	3,597	63	1, 3
18	Cogon	Guiuan	Eastern Samar	1,146	133	2, 6
19	Cantahay	Guiuan	Eastern Samar	1,118	105	3

Shelter categories: [1] Repair and retrofit; [2] Transitional shelter; [3] Core/progressive shelter; [4] Rental subsidies; [5] Hosting support; [6] Resettlement

We excluded households receiving shelter assistance from other organizations outside of the primary project considered within a community. For example, in one community there were three organizations assisting households with shelter assistance; we bounded our analysis to only those households receiving assistance by the organization we identified for inclusion in the study. For each of the shelter projects selected, we collected interview, documentation, and observation data during field visits at 6, 13, 28, and 36 months' post-disaster.

Data Collection

During our first field visit, which spanned four months, we conducted 32 semi-structured interviews with non-governmental (NGO) staff, local government officials, and community members involved in infrastructure reconstruction within the selected communities. Participants stemmed from international and domestic NGOs, local government units (LGUs), the Shelter Cluster, and the

WASH Cluster. Interview questions during this initial fieldwork focused on understanding how coordination of resources was occurring and what stakeholders were participating. Example interview questions included: *"How is your organization currently coordinating rebuilding efforts with other NGOs and local governments?"* and *"How are you involving beneficiaries in your shelter projects?"* In addition to interviews, field notes were recorded from daily observations of reconstruction projects and cluster coordination meetings. These notes encompassed dialogue that occurred during meetings and observation of stakeholder interactions in on-site planning activities. Finally, cluster policy documents, meeting minutes, recovery plans, and technical communication documents were also collected.

A second, three-month field visit was conducted four months later, during which an additional 167 interviews were conducted with stakeholders. Individuals were selected based on continuing reconstruction efforts in projects identified during the first phase. Questions again centered on types of coordination and participation that were occurring, however, this visit focused on coordination and participation within the design phase and participation and training within the construction phase. Example questions included, *'What is being requested of beneficiaries during construction?'* and *'Is your organization providing training to households and, if so, how?'*

Our third, three-month field visit occurred post-project completion. During this visit, in-person surveys were used to collect data on shelter project outcomes. In total, 320 surveys across the nineteen shelter projects were administered. Questions included asking households to assess their access to infrastructure services, such as water, sanitation, power, education, medical care, transportation, and evacuation centers and collect household demographic data, such as family size and income. Households were also asked to assess the quality of their shelter and the researchers noted the condition of each household surveyed. An additional 40 surveys were also given to local government officials to assess disaster management planning and cooperation with neighboring barangays and municipalities. These questions were asked verbally using a translator, similar to the semi-structured interviews, and responses were recorded using a tablet. A final two-week field visit was completed to follow up on missing data and triangulate conflicting information through 12 additional interviews with organization staff and households.

Data Analysis

Interviews conducted across project phases were translated, transcribed, and then imported into NVivo qualitative analysis software. A deductive coding structure was used to first qualitatively code themes into the three selected topics of coordination, participation, and training. In order to operationalize coordination, participation, and training across phases of projects, we first identified project tasks that occurred in each domain. Within each of these, we then inductively coded themes that arose across the studied projects, developing emergent codes. Coding was completed independently by two researchers prior to inter-coder comparison testing to verify themes in the data (Campbell et al. 2013). After themes were determined, inter-rater reliability scores in the form of Cohen's Kappa coefficient were computed for comparison on a 20% sample of interviews. Values in excess of 0.4 are generally considered acceptable (Landis and Koch 1977). In the case that Kappa values were lower than a threshold of 0.4 for the coding of any interview (Landis and Koch 1977), the two researchers revisited the coding to reach consensus. Coding queries were then used to identify conditions for use in fsQCA. We then calibrated our data for fsQCA based on observed variation in each identified condition to explore casual relationships that led to resilience, sustainability, or their combination.

Variable Calibration

Prior to analyzing our data, we first needed to calibrate our raw data. This is a vital step in QCA research that situates the measurement of variables in a theoretical context. In particular, the calibration process makes measurements interpretable. Borrowing an example from Ragin (2009 p. 2), *"With an uncalibrated measure of temperature, for example, it is possible to know that one object has a higher* *temperature than another or even that it has a higher temperature than average for a given set of objects, but still not know whether it is hot or cold."* Preliminary anchor points, membership and non-membership, for each condition were established and a level of precision for the set was selected based upon classifications that emerged from the qualitative coding summaries (Basurto and Speer 2012).

To expand on the process of calibration, take cross-sector integration, a sub-condition of coordination during the planning phase we identified. Drawing from literature we examined whether a given shelter project included livelihood, disaster risk reduction, or water, sanitation and hygiene (WASH) components, either directly or in collaboration with another organization. Each type of activity was assigned a value of 0.33; if a project included all three sectors, then we assigned that case a set score of 1, constituting full membership in the set. If none were present, then the case was assigned a set score of 0, or out of set membership. The presence of one or two sectors was assigned scores of 0.33 and 0.67, respectively. While this example highlights a 4-score set, other fuzzy sets, such as crisp sets (0/1), were used based on theoretical and case knowledge. We then averaged any sub conditions to determinate our primary conditions across phases. For our example, the primary condition was coordination during planning.

As discussed, three macro conditions – coordination, participation, and training – were pre-selected for analysis based on their theorized importance in literature. To unpack these further, and to align with emerging theory of shelter project management after disasters (e.g. Johnson et al. 2006), we opted to situate coordination, participation, and training within phases of projects that included planning, design, and construction. Situating these conditions within phases allowed for greater clarity in operationalizing each construct and deconstructing tasks across time. Within each primary condition, we also identified sub-conditions that were aggregated within each phase by averaging set values.

Planning

For the planning phase of projects, we considered two separate conditions: (1) coordination and (2) participation. *Coordination* was operationalized through three sub-conditions that surfaced during qualitative coding of interviews, which included shelter sector participation, cross-sector integration, and land rights. *Shelter sector participation* was defined as the involvement of the primary shelter project organization in Shelter Cluster activities, such as data reporting and meetings. The Shelter Cluster is one of thirteen existing humanitarian clusters responsible for facilitating coordination after disasters in developing country contexts. The body functions through collective action of humanitarian organizations and organizes meetings and resources for shelter partners. *Cross-sector integration* considered whether the water, sanitation, and hygiene (WASH), livelihood, or disaster risk reduction (DRR) activities were included with shelter support. Finally, *land rights* determined whether the organization or households (depending on who was leading early planning), considered and secured land tenure agreements for the expected lifespan of the shelter. In the case of temporary or transitional projects, this period was often two to five years.

Participation also varied during the planning phase of projects, with two sub-conditions emerging from qualitative coding. The household's ability to *select location* was found to be one of the key tasks during planning which dictate over shelter planning efforts. Additionally, *determination of aid*, or the process through which resources and their distribution were determined, varied in household participation. For some projects, this meant directly assessing and involving households in deciding the type of assistance needed (e.g. shelter, medical support), while others pre-determined the assistance from donor requirements.

Design

For the design phase, we again considered the same two separate conditions as from planning: (1) coordination and (2) participation. During design, *coordination* activities were operationalized through the provision of WASH in shelters and the application of uniform design standards developed by the Shelter Cluster. *Provision of WASH* was included because of its ability to capture the integration of one key sector into the design of shelters. The second component of coordination, the application of *uniform design standards*, considered whether the shelter organization followed collectively decided standards, such as the Shelter Cluster's '8 Key Messages' or in some cases the National Structural Code of the Philippines.

Within design, *participatio*n consisted of household floorplan and layout decisions and government permitting of designs by municipal agencies. For *floorplan and layout*, high household participation involved deciding configurations of shelter elements, whereas its absence was the result of prescribed designs implemented by organizations. While government participation was largely absent from planning in shelter projects, *government permitting* of shelter designs emerged as an area of participation during the design phase. In particular, this consisted of municipal agencies reviewing designs and suggesting modifications to better suit household needs, such as additional doors for expanding structures.

Construction

During the construction phase, two process conditions were identified: (1) participation and (2) training. *Participatio*n emerged from four sub-conditions consisting of sweat equity, material procurement, household financial management, and oversight. *Sweat equity*, or labor contributions, varied greatly across projects—some lacked any formal requirements and others mandated up to 2,000 hours per household. *Material procurement* was another area of observed household participation, where materials were obtained by the beneficiary. Alternatively, projects directly procured materials, often for logistical, efficiency, or quality control reasons. *Household financial management*, the participation of households in controlling resources during construction, emerged as a sub-condition from the interviews. Practical examples of this include cash transfers, where the household would hire labor and oversee the project's budget. Lastly, *oversight* surfaced from interviews and has been identified in research literature as an area of participation during construction (e.g. Jordan et al. 2016). While most organizations inspected construction, some projects also afforded households the ability to participate in verifying construction quality.

Previous research has analyzed the influence of *training* on construction knowledge retention, based upon the principles of safer construction disseminated by the Shelter Cluster and found that retention of knowledge was achieved through the diversity of methods employed by formal training programs or observation of construction by the beneficiary (see Chapter 4). Thus, we included two sub-conditions for training during construction that included diversity of methods and on-site observations. *Diversity of methods* captured whether the training used multiple methods to educate households and builders on new construction techniques. For example, we considered whether lectures, demonstrations, and technical drawings were used in combination or isolation. *On-site observations* captured whether the households were present on the construction site.

Outcomes

For both outcomes of interest, resilience and sustainability, we used the metrics outlined earlier (see Table 5-1 and Table 5-2), drawing from literature to define sub-outcomes. After calibrating each sub-outcome, we averaged within each dimension and then averaged across dimensions to aggregate to a single resilience and sustainability fuzzy score for each case. Within dimensions of each outcome, we averaged sub-conditions as we expect that some measured characteristics may be able to compensate for others. For example, for the social dimension of resilience, high social capital among households may compensate for the lack of community organizations. For housing design and quality within resilience, we aggregated by taking the minimum value, as the lower value was found to control the contribution of housing to resilience. When considering the combined outcome of resilience and sustainability, we took the minimum value for each case – the lower value controlled the presence of the combined outcome. By taking a minimum value of each independent outcome, we assume that the combined outcome cannot exist without the presence of both. Our full truth table is shown below in Table 5-4.

Table 5-4: Resilience and Sustainability Truth Table

Case	Community	PlanCoord	PlanPart	DesCoord	DesPart	ConstPart	ConstTrain	Resilience	Sustain	Combined
1	Okoy	0.78	0.70	0.67	0.67	0.17	1.00	0.59	0.70	0.59
2	Maricaban	0.68	0.00	0.33	0.00	0.50	0.50	0.36	0.60	0.36
3	Poblacion	0.44	0.00	0.00	0.00	0.50	0.00	0.46	0.22	0.22
4	Sungko	0.11	1.00	0.00	0.00	0.35	0.00	0.47	0.45	0.45
5	Sillon	0.44	0.00	0.33	0.00	0.50	0.00	0.35	0.37	0.35
6	Kangkaibe	1.00	0.00	0.33	0.00	0.50	0.50	0.39	0.67	0.39
7	Tagpuro	0.44	0.00	0.33	0.00	0.50	0.00	0.40	0.21	0.21
8	Pago	0.46	0.00	0.33	0.00	0.50	0.50	0.29	0.37	0.29
9	New Kawayan (101)	0.22	1.00	0.00	0.00	0.85	0.84	0.69	0.73	0.69
10	Bagacay (93)	0.78	0.00	0.33	0.00	0.17	1.00	0.43	0.69	0.43
11	San Agustin	0.22	0.00	0.33	0.00	0.34	0.34	0.39	0.27	0.27
12	San Jose (83C)	0.78	1.00	0.33	0.67	0.50	0.50	0.68	0.85	0.68
13	Magallanes (52)	1.00	1.00	1.00	0.67	1.00	0.50	0.42	0.45	0.42
14	San Jose (85)	0.57	1.00	0.00	0.00	0.67	1.00	0.42	0.65	0.42
15	Hiabangan	0.68	1.00	0.00	0.00	0.50	0.84	0.72	0.75	0.72
16	Sagkahan (62)	1.00	1.00	1.00	0.67	0.50	0.67	0.73	0.88	0.73
17	Sulangan	0.78	0.70	1.00	0.67	1.00	1.00	0.58	0.59	0.58
18	Cogon	0.56	0.00	0.33	0.00	0.50	0.00	0.50	0.42	0.42
19	Cantahay	0.67	0.00	0.00	0.33	0.85	1.00	0.30	0.38	0.30

Analyzing Casual Pathways

After completing our truth table, we then used fsQCA software (Ragin 2006) to analyze pathways. We assessed the usefulness of pathways using two metrics: *consistency* and *coverage*. Consistency measures the degree to which cases with a given set of factors or conditions exhibit the outcome, where a consistency score of 0.8 is required and coverage measures the degree to which a given pathway explains the cases analyzed, indicating the relevancy of each pathway (Rihoux and Ragin 2009). During this analysis, we also determined which individual conditions were *necessary* or *sufficient* to produce the outcome, where necessity is a measure of the degree to which the outcome is a subset of the causal condition and sufficiency provides a measure of the degree to which the causal condition is a subset of the outcome. We conducted this analysis for both resilience and sustainability independently, and then in combination.

To reduce our logic space, or the number of possible condition values, we made simplifying assumptions for each condition (Kaminsky and Jordan 2017; Ragin and Sonnett 2005). In this particular study, the expected theoretical direction of relationships between our conditions and outcomes to be positive. We would expect the presence of any of the conditions selected to result in the presence of either outcome. For example, we would expect that the presence of coordination during planning would lead to resilience, not the absence of coordination. We then performed an initial screening of condition necessity scores for each outcome, assessing whether the outcome was a subset of a condition. None of the conditions displayed low necessity, defined as less than 0.3, thus we included all six conditions in our final analysis for both outcomes in isolation and combined.

Findings

We discuss our findings for each outcome individually and then conclude with a discussion of themes identified across the outcomes and projects. In the following sections, we present the solutions identified for each outcome in a diagram. A "*" denotes the "and" Boolean operator. The absence of a condition show by a "~" before a condition.

Resilience

Six of the identified nineteen projects showed the presence of resilience across all four dimensions considered (infrastructure, governance, economic, and social). To reiterate, we defined resilience as the capacities required to support community infrastructure system functionality after a disaster, shown in Table 5-1. We found two pathways, shown in Figure 5-1, that collectively had a solution consistency of 0.87 and a coverage of 0.48.

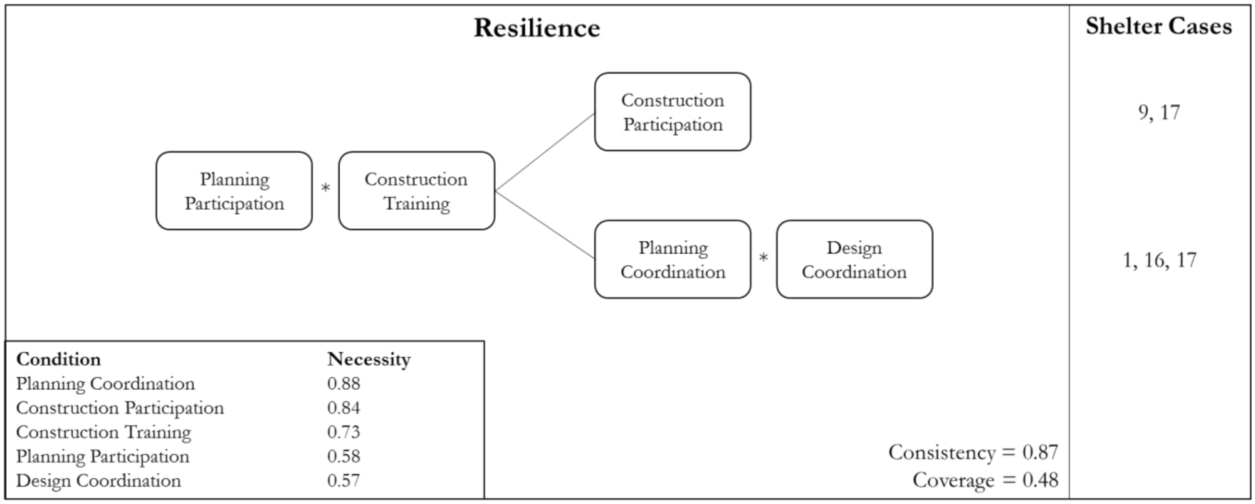

Figure 5-1: Resilience Pathways

Both pathways included participation during planning and training during the construction phase of projects. Coordination during planning was found to be nearly necessary to achieve resilience, with a necessity value of 0.88, although it did not appear in one of the two identified pathways, reinforcing that there still an alternative pathway to achieve resiliency. In all but one of the cases that exhibited resilience, projects included support for other sectors beyond just shelter, including WASH, livelihood, and DRR aspects, displaying strong coordination across different settlement dimensions. One NGO manager described the intent of this early integration, *"The effect of Yolanda (Haiyan) gave us a picture that it is not only houses that are damaged; it is the people or the settlement. So, during the preparation of the project, we ensured that the project will not only focus on building houses. It should be rebuilding back the settlement or the habitat where the community, and where the people are living."* In communities that did not achieve resilient infrastructure outcomes, we noted an absence of early coordination, which lead us to validate the importance of this condition. For instance, in a shelter project that lacked coordination during planning, a beneficiary described the loss of water service after Typhoon Hagupit approximately a year after Haiyan, *"Before they used to deliver water every Tuesday, Thursday, and Saturday, but lately after Typhoon Ruby (Hagupit), it has not taken place."* In this case, there was a lack of early coordination that directly led to the later failure of water service delivery. While shelter activities were coordinated during planning for this project, other services were omitted from coordination because of the expected temporary nature of the project, despite the continued occupancy of shelters over two years beyond their intended lifespan, at the time of observation.

In addition to participation during planning and construction training, the first pathway also included participation during construction. Both projects that fell into this pathway provided in-situ shelter assistance, allowing households to select the location where their shelter would be built. One of the projects used a conditional cash-transfer and the other provided materials. The organizations for these projects spent extensive time and resources involving households in the needs assessment to determine aid provision. In addition, all three projects provided training to both household beneficiaries and carpenters constructing shelter to supplement material or cash assistance with knowledge. This was particularly helpful in ensuring that resources were allocated toward more robust designs and construction techniques. Deconstructing the types of participation during construction for these programs further, household participation was centered on decisions, such as overseeing construction finances or verifying the quality of construction work completed. While one of the projects required beneficiaries to procure materials as a condition of receiving assistance, neither had sweat equity requirements, which were observed in the other projects studied, and thus the households relied on hired labor for construction.

The second pathway had two additional conditions that included coordination during both the planning and design phase. In contrast to the first pathway, two of the projects that fell into the second pathway were built directly by the assisting organization. Construction training within these communities was aimed at skilled workers, and in contrast to the first pathway, did not include households. Significant participation during planning was also found within this pathway, consisting of tailored household assessments and the ability to select the shelter location. The chief addition from this pathway, however, was coordination across both planning and design phases. The cases paralleled our discussion above of early participation, however the noticeable trait of design coordination was adherence to uniform design standards. For two of the projects, standards developed by the Shelter Cluster were used to guide designs, while the third project relied on the National Structural Code of the Philippines.

In summary, we see that shelter projects that led to resilience had early participation and trained either households or skilled labor during construction. One NGO staff described the combination of these project conditions, *"We don't do anything [directly], people will have to do it, we can facilitate and train them to do it. We aren't procuring anything – only if they lack and we can't mobilize locally, then we can assist to guide that process…. It is integrated so we aren't sectoral. We leave it up to the community to set their priorities. We can't define any outputs yet because that is defined as part of the process."* In addition to early participation and training, either construction participation or consistent coordination across phases was required.

Sustainability

We broadly found that shelter projects supported infrastructure sustainability, or the ability to maintain infrastructure assets over time. The means through which projects achieved this outcome, however, varied across cases, as will be discussed below. Ten of the nineteen project cases showed signs of high sustainability with five projects identified in two pathways to the outcome. For the five projects not included in the pathways identified but exhibiting the sustainability outcome, the primary reason was ambiguity in whether there was membership in participation during construction. Indeed, in the two pathways identified, one pathway included the absence of participation during construction while the second pathway included the presence of the same condition, highlighting how such participation can be both beneficial and detrimental to sustainability. Similar to the outcome of resiliency, coordination during planning was found to be nearly necessary, or close to a necessary condition value of 0.9, for sustainability, with a necessity value of 0.89. Our solution had an overall consistency of 0.93 with a coverage of 0.68. A summary of the pathways identified can be found below in Figure 5-2.

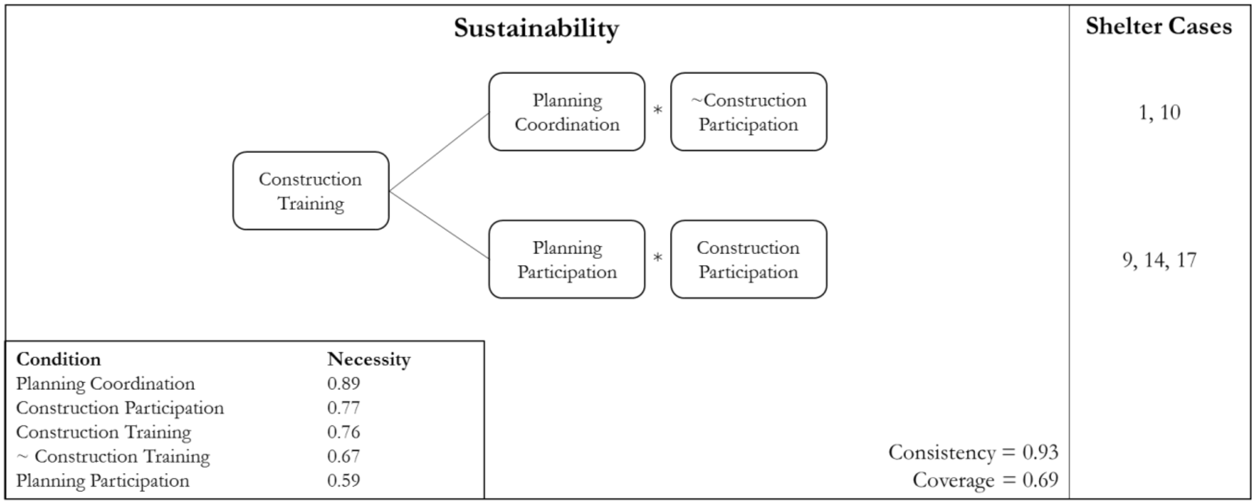

Figure 5-2: Sustainability Pathways

Construction training was common to both pathways, the result of supporting households construction knowledge, local workforce skills, employment, and increased income. A project manager described the impact of training, *"From the start we trained more contractors. I mean this way they get some sort of livelihood. But more than that, when the time comes, you know something similar, God forbid, they will know how to build back, because they have done it in their communities."* In the first pathway, training targeted skilled labor, using multiple methods to train carpenters. Community members also received training in multiple formats at length. For example, one project incorporated a month-long program to educate households on safer building and maintenance of shelters.

In addition to construction training, the first pathway also included coordination during planning and the absence of participation during construction. Both of the projects that fell into this pathway relied on directly building shelters for beneficiaries and were 'core shelters' intended to provide a secure dwelling that could be expanded in the future. In addition, both projects also secured land tenure during early coordination, however it is noteworthy that the second project in this pathway mandated

30 square meters of titled land in order to receive assistance, disqualifying many low-income households from receiving shelter assistance. Finally, the absence of participation during construction found in this first pathway can be attributed to the modality used to deliver shelter assistance – in this case direct build core shelters.

In contrast, the second pathway included the presence of participation during construction and participation during planning, in addition to construction training. Participation during the planning stages of projects resulted in modalities of assistance that closely tied with individual household objectives. For example, in one project, a majority of households were located on flood-prone land, but there was a strong desire to stay for social and economic reasons. Further, while shelter was determined to a priority, differing living arrangements were preferred, such as support for being hosted by a family member, retrofitting an existing structure, or new construction. The shelter packages developed through this planning process catered to individual needs, leading to sustainable solutions by providing early choice. In contrast, projects that did not allow early participation of households in making these decisions, had significantly lower post-construction occupancy rates. For example, several projects mandated relocation to areas outside of the 'no-build zone,' leading to occupancy rates frequently below 50 percent. Further, early directives made by households during planning led to oversight of these directives by beneficiaries during construction. Their early buy-in during planning helped lead to a desire to maintain control and direction during the later construction phase.

In comparing the two pathways, we can see that the first set of projects relied on simple and uniform shelter designs. As a result, the projects were completed significantly quicker, but afforded less customization, resulting in a basic one room structure which would be expanded upon. As a sign of early success of this approach, we found that 89% of households for these projects had expanded on their shelters within a year of completion. This validates the capacity and ability of the households to maintain their shelter. For projects in the second pathway, the projects relied on 'owner-driven' or 'self-recovery' approaches. These modalities leveraged household-builder relationships and scoped planning to align with evolving recovery through training and participation during construction as well as early participation. Training to households allowed for more informed decisions in selecting builders and quality control of construction, which was overseen by the beneficiary.

Combined Resilience and Sustainability

In addition to assessing the individual outcomes of sustainability and resilience, we also explored pathways that led to the presence of both outcomes. Interestingly, we did not find any cases that exhibited resilience that did not also have high sustainability. As a result, when we analyzed the pathways to combined resilient and sustainable infrastructure outcomes, the pathways were identical to the resilience pathways previously discussed. We found six cases that exhibited a combined outcome of resilience and sustainability; five of the cases were captured by our pathways. Our solution consistency and coverage changed slightly and were 0.87 and 0.51, respectively. A summary of the combined outcome pathways is shown in Figure 5-3.

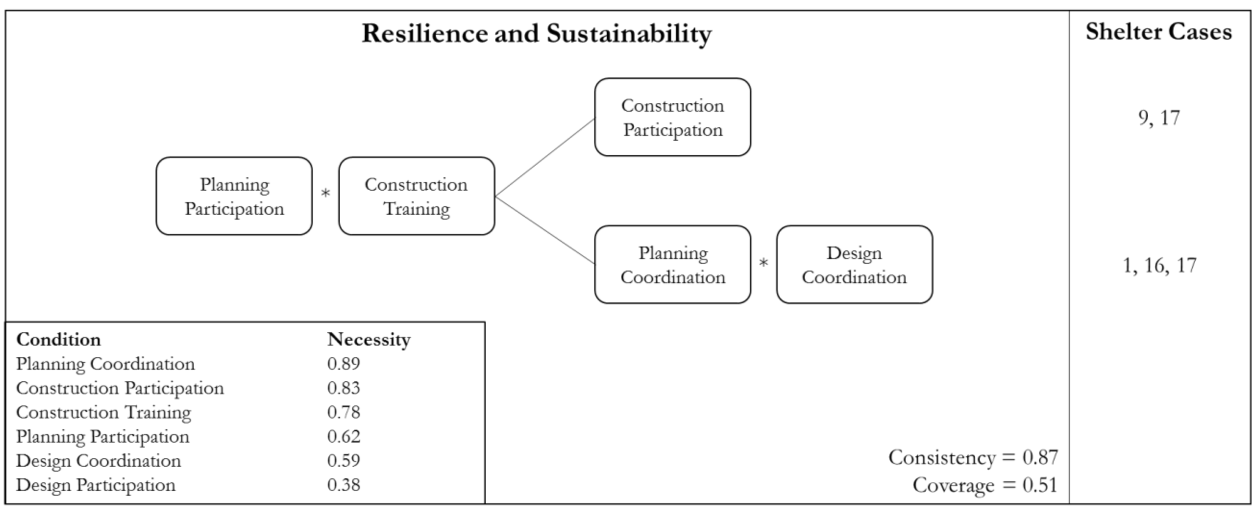

Figure 5-3: Combined Resilience and Sustainability Pathways

Discussion

There are several themes that surfaced across pathways to the individual and combined outcomes. In analyzing unique outcomes, we found that more projects resulted in sustainable rather than resilient community infrastructure. Despite shortcomings in infrastructure system resilience, all of the cases that showed the presence of resilience, also achieved sustainability. Many of the building practices that are prominent across the regions studied have been passed down for generations; supporting and replicating these construction practices in recovery allowed for continuity of these norms. Settlement patterns also have inherently adapted to meet household needs, for example, shelters are often built in proximity to water and livelihood opportunities, such as fishing. These settlement practices inherently consider sustainable integration of social and economic linkages.

More broadly, we hypothesize that the higher number of cases exhibiting sustainability compared to resilience may be related to awareness in the humanitarian sector of these two outcomes; sustainability as a concept emerged in the 1980's while resilience has only recently come to the forefront of disaster practice. Additionally, many humanitarian organizations openly discussed that providing permanent solutions was not their intent and noted the difference in mandates between development and humanitarian sectors. Our analysis supports that this mindset often translated into programming, leading organizations to set up the building blocks for long-term recovery, but neglected their potential role in transitioning to resilience building. Further, the limited presence of resilient infrastructure suggests that there may be a minimum level of resources, either financial or social, required that exceeds those capacities needed for sustainability. For example, restoring pre-disaster livelihoods may yield income levels that are adequate to maintain the functionality of reconstructed infrastructure, yet these employment opportunities may be insufficient to allow for investment in risk reduction measures, such as more robust construction.

None of the studied relocation projects achieved either sustainable or resilient outcomes. Simply put, the upheaval of social and economic ties was detrimental. In several cases observed, households were required to spend over half their income on transportation back to economic centers for their livelihoods. Water, electricity, and sanitation services were also frequently absent or sub-standard quality, consistent with past research on relocation projects (Mallick et al. 2011). This distanciation of opportunities and services resulted in rapid degradation of infrastructure, with notable signs of disrepair occurring as quickly as one year after completion of shelters. However, the point in time at which our outcomes were assessed may explain the reason that none of the relocated communities had achieved the studied outcomes, as it is expected to take years before even basic services are completed on many of these sites. Despite potential for these sites to prosper in the future, past research and early indicators suggest that such claims should be approached with caution.

As our pathways demonstrate, well-conceived project processes have the potential to positively impact infrastructure outcomes. Coordination, participation, and training at the right points in time offer the ability to align project goals with needs, support strong local economies, and improve living conditions. For our combined outcome, two conditions in particular were important – participation during planning and training during construction. The importance of early involvement of project stakeholders aligns with broader theory in housing assistance literature (Lizarralde et al. 2013; Lizarralde and Root 2008), suggesting that early decisions form a foundation on which later project tasks are formulated. We operationalized this participation through location selection and determination of aid. The former of these decisions suggests that is important to situate shelter project assistance within individual settlement choice while the later points to aligning how this assistance is conceived.

In comparing the two pathways to a combined resilience and sustainability outcome, two types of project modalities emerged. In the first pathway, the projects provided resources and technical assistance, allowing for high levels of household efficacy over project processes. In the second, projects integrated multiple sectors. Notably, a majority of projects continue to view programming as delivering shelter products rather than processes. Shifting thinking towards programming that embeds shelters within broader recovery strategy is not only needed, but imperative; the absence of such measures is in danger of making the humanitarian shelter sector irrelevant. Practically, this means aligning modalities of assistance with community needs through flexible donor requirements, leveraging local capacities in planning, and relinquishing control to beneficiaries. Such measures are built upon trust which require rethinking the mechanisms of humanitarian assistance. Rather than pitting donors, aid organizations, beneficiaries, and local governments against each other, it is crucial that we establish incentive structures that encourage reaching toward collective goals.

Limitations

The largest limitation of our study is that we focused specifically on shelter projects when seeking to explain differences in broader community infrastructure outcomes. Shelter assistance was only one part of assistance provided to many of the communities, and while we sought to control for, and capture, all assistance being provided to communities, we recognize there are other potential casual conditions missing from our analysis, such as the pre-disaster state of infrastructure. Despite this, the moderate to high coverage of our solutions suggests that we were able to explain most of the variation with our solutions. Further, by spending extensive time in the field, we have attempted to mitigate extraneous variables that may have been needed to explain outcomes.

Conclusions

Foremost, we have taken a step toward providing clarity in the operationalization of resilience and sustainability in infrastructure systems, answering calls to bring specificity to these outcomes in practice (Bocchini et al. 2013; Rodriguez-Nikl 2015; Tobin 1999). Our adaptation of current resilience indicators from developed countries (e.g. Cutter 2016) and sustainability indicators from development contexts (e.g. Ugwu and Haupt 2007) provide a useful tool to replicate assessing both of these outcomes. In particular, our calibrations are a tool for researchers seeking to measure and quantify resilience and sustainability in post-disaster contexts in developing countries. Additionally, we have opened the door to understanding the link between long-term operation and maintenance of infrastructure and the social, economic, and governance mechanisms that support functionality after disasters.

Our findings also further develop understanding of the project processes required to facilitate effective reconstruction after disasters. This work builds on previous efforts to connect management and disaster literatures (Johnson et al. 2006) as well as further develop theory of project governance in developing countries (Lizarralde et al. 2013; Lizarralde and Root 2008). We do this by deconstructing three project processes – coordination, participation, and training – across project phases and assessing the impact of each, in isolation and combination, on resilience and sustainability outcomes.

We found that participation in planning and construction, combined with either training or coordination across phases, was influential for resilient and sustainable infrastructure outcomes. Theoretically, this points to the need to attend to different types of participation, coordination, and training, and understand the interaction between project elements in achieving outcomes. For instance, training is often necessary to be able to participate in construction processes – only attending to participation neglects the importance of knowledge transfer and skills need for this participation to be effective.

Practically, our findings point to three main recommendations that include: (1) shifting from product delivery approaches to individual household recovery processes; (2) more fully integrate construction training and skills development into humanitarian shelter assistance, (3) identify and support long-term linkages to recovery. In regard to the first recommendation, our findings point to the need to broad what constitutes shelter programming. In place of envisioning shelter as 'four walls and a roof,' practitioners must begin to bring livelihoods, disaster risk reduction, and other sectors into proposed shelter activities. Rather than wait for broader reform in the humanitarian system, such as restructuring of the cluster system, organizations need to proactively seek out opportunities to bring beneficiary services together. Secondly, shelter projects must begin to include a training component. Less than half of the projects we studied had a formal educational component focused on safer building. Not only is an effort needed directed at households, but also at local contractors. Lastly, there is a need to align humanitarian shelter projects with long-term recovery objectives. In practice, this means ensuring linkages to transition from the start. For example, if transitional shelter is selected as a modality, it is imperative to identify needed steps to ensure sufficient upgrading or transfer to permanent solutions. Too often, the humanitarian shelter sector has hidden behind the veil of its mandate without consideration for repercussion of actions taken. Establishing a cohesive agenda for the humanitarian and development sectors should continue to emerge as priority at an institutional level (Ki-moon 2016).

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CHAPTER 6 CONCLUSION

Within the four chapters of this dissertation, I investigated humanitarian shelter projects, analyzing inter-organization coordination, stakeholder participation, construction training, and the intersection of these processes within, and across, project phases. The chapters collectively answer the overarching question of *what combinations of coordination, stakeholder participation, and training across project delivery phases lead to resilient and sustainable community infrastructure systems?* A summary of contributions from this dissertation can be found in Figure 6-1.

Each of the first three chapters focused explicitly on one of the three identified themes, and the fourth chapter explored the intersection of all of three themes together. Chapter 2 investigated inter-organization coordination and division of labor among humanitarian organizations, finding that social communicative practices are foundational in reinforcing boundary spaces of coordination. In Chapter 3, I unpacked stakeholder participation in shelter projects, which resulted in a framework of eight project tasks that varied in their levels of household and government participation. Within this chapter, I also used fsQCA to analyze the impact of participation on household shelter satisfaction and safe shelter design. This revealed that participation was vital during early planning stages of projects to realize the considered outcomes. Next, Chapter 4 examined construction training formats used by organizations, identifying six commonly used training formats in shelter projects that included diagrams, lectures, demonstrations, hand-outs, posters, and photos. The impact of these methods on construction knowledge was also assessed using fsQCA, revealing that households either acquired construction knowledge through formal training that utilized diversity in training methods or through on-site observations. In Chapter 5, fsQCA was used to analyze combinations of coordination, stakeholder participation, and training to assess their impact on resilience and sustainability of community infrastructure systems. Participation during planning was once again found to be critical; additionally, training during construction also emerged as an important condition for both outcomes.

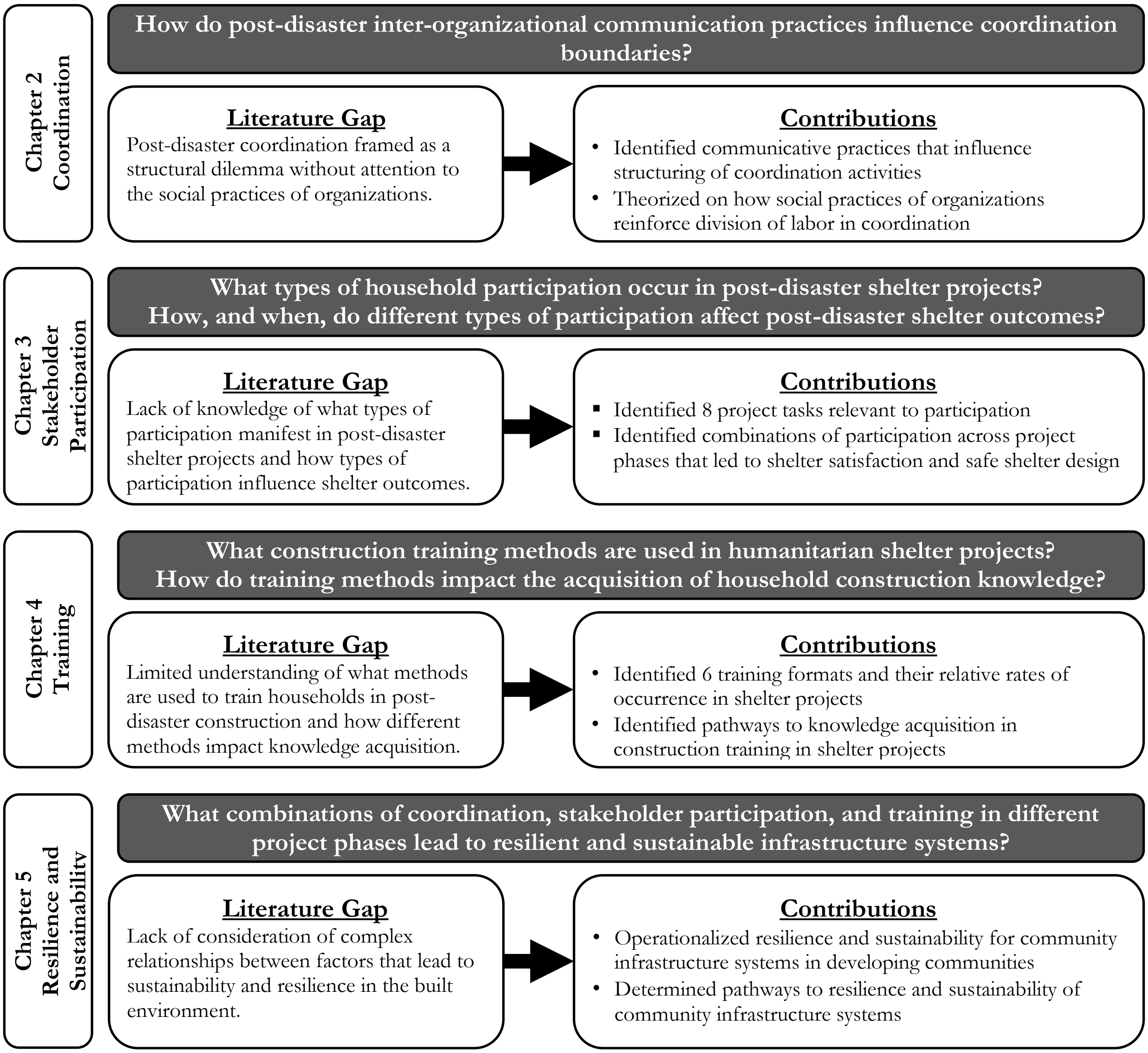

Figure 6-1: Summary of Research Contributions

Theoretical Contributions

The findings of this dissertation reveal new *processes* and *organizing structures* necessary for resilient and sustainable systems, building theory of reconstruction process pathways, including coordination, stakeholder participation, and training that enable resilient and sustainable infrastructure. While the link between shelter and broader disaster recovery outcomes is well established (Mileti 1999; Quarantelli 1982), theory of project management to support shelter reconstruction is sparse in literature (Vahanvati and Mulligan 2017).

Chapter 2 used emergence theory (Goldstein 1999) to explain how organizational social practices form the basis of coordination structures in humanitarian response. By grounding coordination in a communicative lens, I challenge the notion of rationality in the process of organizing division of labor. Chapter 3 operationalizes participation in humanitarian shelter, answering calls to bring greater clarity to participation in project contexts (Davidson et al. 2007). The findings build on theoretical frameworks of participation (Arnstein 1969; Choguill 1996) by proposing eight underling participatory project tasks which can be used to assess future participation in humanitarian projects. The results further challenge long-held norms of viewing participation as monolithic, bringing a more granular understanding of the impact of stakeholder inclusion in humanitarian shelter projects. In analyzing the impact of different types of participation in combination, the chapter also develops new theory of the casual links between participation and shelter outcomes. Chapter 4 used experiential learning theory (Kolb 1984) to examine training formats and their impact on construction knowledge acquisition. In grounding learning in experiences, this chapter builds new theory on the role of education in strengthening local capacities. The findings point to two pathways to knowledge acquisition by households through diversity of methods in formal training and informally through on-site observation of construction activities. Chapter 5 builds upon calls to theoretically differentiate resilience and sustainability in the built environment (Bocchini et al. 2013; Rodriguez-Nikl 2015; Tobin 1999). The identification of casual pathways develops understanding of the complex relationships of project variables that influence outcomes. In particular, participation and later training, in combination, were important for project outcomes.

Few studies existing studies have observed post-disaster recovery in real time over a longitudinal period. The studies that do exist (e.g. Snarr and Brown 1980, 1982, 1994), focus on evolving *post-project* outcomes. The result is that most theory of managing shelter projects has been constructed through recounts of project processes – presenting decisions and actions as oversimplified and logical. In reality, project tasks are contested sites of social negotiation. Further, the importance of time has only recently taken footing in disaster literature (Olshansky et al. 2012), but plays a central role in shifting thinking of traditional disciplinary boundaries. A major contribution of this dissertation is the development of a longitudinal theory of shelter project processes and their impact on project outcomes.

In this dissertation, I have taken a methodical step toward understanding the complex relationships between shelter project elements by drawing upon qualitative comparative analysis. This research builds on a growing number of studies in the disaster field which have used the method (Binder 2015; Jordan et al. 2014, 2016; Marín et al. 2015). The manner in which fsQCA was applied in this dissertation provides new potential for scholars seeking to use the method, either in the disaster field or elsewhere. Notably, conditions selected for inclusion were bounded temporally. The ability to unpack conditions into unique time periods allows for greater precision in measuring underlying social phenomena and affords more detailed theoretical perspectives. Real-time data collection of processes also presents new opportunities for QCA researchers.

Practical Relevance

As Kelman et al (2011) suggest, operational research into post-disaster shelter seeks to answer two core questions: 'Why is post-disaster settlement and shelter implemented the way it is seen to be implemented?' and 'How could the situation improve?' The findings of this dissertation provide practical answers to these questions in several areas.

The investigation of coordination practices in Chapter 2 presents a basis for understanding grounded social behaviors of organizations. In light of efforts to reform the humanitarian cluster system, there is a need to look beyond the structuring of coordination to grounded social behaviors of organizations. As I have demonstrated, coordination is a *social* process and top-down approaches to impose coordination rarely achieve the results they intend to orchestrate. At a global level, agencies should seek to support localized coordination and build upon emergent interaction of organizations. The findings of this dissertation point to the importance of place in coordinating and attempts to reduce duplication of services and alignment of strategy must continue to support efforts to localize division of labor by humanitarian organizations. An emphasis on supporting response and recovery within socially defined spaces has the potential to shift thinking from sectors (e.g. shelter and WASH) to settlements. Rather than a content based cluster coordination system – future efforts might consider clusters bounded by social settlement patterns.

In addition to physical boundaries, my analysis suggests that language constitutes a demarcation of humanitarian actors. There is a need to establish common language across humanitarian sectors as the proliferation of terminology has created, and reinforced, sectorial boundaries. In the context of findings in the final chapter of this dissertation, the integration of sectors was found to be key in the creation of resilient and sustainable infrastructure systems. As the constitutive perspective that I draw upon suggests, breaking down sectoral silos necessitates processes of co-creation. As long as humanitarian organizations continue to operate in boundaries determined by technical fields, rather than affected population needs, jointly created language will be difficult to achieve.

There has been much discussion trying to rethink the modalities of delivering shelter assistance in the face of dwindling resources for humanitarian organization, with growing emphasis placed on 'self-recovery' or 'owner-driven' models. Findings from Chapter 3 reinforce the effectiveness of such approaches in providing higher satisfaction among beneficiaries; however, organizations should cautiously approach giving uninhibited household control over design. There is a need to maintain a certain level of organizational control over design or provide sufficient technical support and training to households to ensure adequate design outcomes. Further, organizations should be wary when seeking to use participatory approaches as these often place undue time and cost burden on recovering households. Satisfaction was just as high for smaller contributions that were not as burdensome on the families, and the purpose of participation should be critically examined in advance. As others have suggested (Cooke and Kothari 2001; Rand et al. 2011), poorly conceived participation can quickly become tyrannical in nature.

Chapter 4 has implications to re-conceptualize technical assistance and training provided to communities. In particular, the acquisition of knowledge through observations is promising for organizations, in part, because it shows that not every household needs to receive formal training, which is often a time and cost intensive endeavor. For those households or skilled labor that do receive formal training, organizations should ensure that multiple formats are combined to embed learning in past experience, reflection, critical thinking, and application. Rather than view learning from Western imposed learning models, organizations should seek to provide training within local customs and cultures, such as storytelling and other indigenous methods of generational knowledge transfer. Pilot shelters were one of the simplest methods of affording the ability to observe safer construction techniques and future shelter projects should seek to use demonstration shelters as a means to allow for observations.

Chapter 5 reveals a plethora of insights for organizations seeking invest in post-disaster infrastructure reconstruction. Foremost, shelter is an essential component of recovery, but it must to integrated into holistic programming. Similarly, 'hardware' alone is not enough to achieve these outcomes. Humanitarian programming must also support social, economic, and governance activities if assets are to be resilient and sustainable. In line with past findings (Davis 2011), organizations should seek to situate shelter assistance within established settlement patterns.

Limitations

There are several limitations of this dissertation that merit discussion. In Chapter 2, coordination was primarily examined through interview data, likely resulting in some selection bias in the themes that surfaced. This is true of any qualitative study, however, I have attempted to mitigate any interview biases by triangulating with other sources, such as observations and documentation. Further, as my focus of this dissertation was on shelter projects, there was an emphasis placed on the shelter sector. As observed during data collection, other sectors (e.g. WASH) were found to function independently and operated through different social norms. In Chapter 3, I focused on the impact of participation across project phases on household satisfaction with shelter and safe shelter design. Notably, these participation processes were likely not the only variables that influenced these outcomes – organizational staffing and the state of pre-disaster shelter are two variables that are expected to influence these outcomes that were not included.

In Chapter 4, I focused on training programs and community construction knowledge. In attempting to understand factors that lead to higher construction knowledge, the primary limitation was the inability to collect pre-training test data. As a result, I was unable to comment on whether communities saw changes in construction knowledge after training; the outcome selected only looked at the final state of knowledge achieved by communities. One of the main limitations in Chapter 5 was the aggregation of conditions used in QCA, as combined conditions and outcomes gravitated closer toward the crossover point of sets. While this afforded the ability to investigate and capture broader project processes, some conditions and sub-outcomes were suppressed through this methodological decision.

There continue to be calls to expand to multi-national studies of disasters, however collecting data of sufficient depth that is comparable continues to present a significant challenge. In this research, I sought to take an intermediate step by examining a larger sample of shelter projects, expanding on literature that is predominantly based upon single case studies. The vast amount of on-site researcher observations, larger number of interviews across stakeholder groups, and extensive documentation provide a means to distill common themes that are expected to broadly translate to other humanitarian contexts. Given the diversity of organizations responding and unique local challenges that arose, there is compelling evidence to support that findings of this study go beyond just a single disaster 'case.'

It is worth discussing to what extent the findings of this research may be applicable to other contexts. As others have argued (Field 2017), the Philippines presents a unique case because disasters have become so embedded within society. This begs the question of how generalizable are findings from such a context? As Bankoff (2003) states, *"While 'natural disasters' are not a conceptual term in the same way that topicality and development are, the region in which such phenomena most frequently occur have been incorporated into a discourse about hazard that sets them apart from other implicitly 'safer' area."* While there are no doubt political, social, and economic differences between the Philippines and other humanitarian response contexts, there remains a common discourse that pervades humanitarian practice. Notions of authority, power, vulnerability, and the social enactment of these concepts between humanitarians and local actors is a constant. To assume that each disaster context is entirely unique is to ignore the institutions that compose them. While scholars frequently note that there is nothing 'natural' about a disaster (O'Keefe et al. 1976); they are socially constructed, rarely are the social patterns of international actors considered to constitute part of the disaster. To envision the applicability of findings of this work, considerations of the broader institutions and actors present point to reoccurring themes across national borders.

Future Work

As evidenced by an ever growing number of shelter case studies (Ashmore 2009, 2010; Ashmore et al. 2013; Fowler and Kennedy 2015; Piccioli et al. 2017), humanitarians have amassed a large number of comparable cases, but establishing a cohesive theory of shelter in disasters has largely remained elusive. Attempts at cross-case comparison have been sparse, with particularly little effort to synthesize findings across projects within responses. In practice, each response will always be reliant on the specific context, but we have yet to truly understand how to support shelter reconstruction during recovery; we lack a comprehensive theory of shelter recovery.

Despite these shortcoming, we are at the cusp of a paradigm shift in humanitarian practice. The number of disasters are far exceeding the ability of organizations to respond to needs. As result, there is considerable effort to understand how to scale solutions, and importantly leverage local capacities. In reflecting on the work completed in this dissertation and broader disaster literature, there several areas that merit future research. Perhaps the most pressing is the need to continue to understand outcomes of different modalities of delivering shelter assistance. While I have attempted to synthesize categories of shelter assistance (e.g. temporary, transitional), what elements constitutes each remains ambiguous. Improving the implementation of these approaches requires a common language that scholars can draw upon. Lesser researched modalities, such as rental subsidies and hosting, hold significant potential in increasingly complex crisis and urban environments.

The collection of data for this research was demanding, time intensive, and at times findings were elusive in the moment; these challenges epitomize longitudinal research. While there are a handful of studies that have examined long-term outcomes of shelter (e.g. Jordan et al. 2015; Rand et al. 2011), future work is needed to understand maintenance, adaptations, and occupancy. In a similar fashion, there is also a need to continue pushing the methodological boundaries used in shelter research. Too often scholars have resorted to using single case studies to examine shelter, leading to largely anecdotal findings that lack generalizability. Other areas touched upon in this dissertation that merit future research also include the link between shelter and disaster risk reduction, transition and evolution of shelter over time, relocation, and minimum shelter cover space standards.

If this task sounds daunting, that is because research of humanitarian shelter is quite frankly not keeping pace. During my dissertation, there was a broader problem that began to surface; the humanitarian shelter sector lacks an operationalized research agenda. As the scale of responses continue to grow and new challenges arise, research continues to lag behind the pressing issues facing humanitarian organizations. There is lacking clarity and prioritization of problems facing humanitarians. Take for example coordination – it remains a steadfast point of angst among practitioners, yet few viable options have surfaced following the establishment of the cluster system in 2004. I believe this is in part due to ill-conceived framing of current issues facing the sector. A decade ago duplication of services was a primary concern, yet evidence following Haiyan demonstrates this was rare. Instead, new issues have come to light, such as sectoral programming that poorly aligns with affected population needs, yet these issues remain buried or absent from literature. Further, there is also a need to revisit past theories in light of current events. Participation is just one example which was covered in this research, but others include notions of disaster risk, building safety, and evacuation. In the years ahead, it is vital that scholars seek to build consensus on a common agenda to frame research questions in humanitarian shelter.

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APPENDIX A AN OVERVIEW OF THE TYPHOON HAIYAN RESPONSE

Home to more than 100 million people, the Philippines ranks as the 12th most populous country in the world (World Bank 2017). Composed of more than 7,000 islands, the country is scattered across a landmass that encompasses 299,404 square kilometers (115,601 square miles). Historically, the Philippines has been one of the most hazard prone countries in the world. Its low elevations, vast coastline, and socioeconomic inequalities pose complex development challenges. In the recent United Nations World Risk Report, the Philippines ranked as the third most risk prone country, only behind Vanuatu and Tonga – a dangerous combination of high exposure and prevalent vulnerabilities (Garschagen et al. 2015). In the last ten years alone the country has seen an average of nearly nineteen disasters annually[1], and nearly half of these hazards have caused devastating loss of life and damage. Historical records of annual numbers of typhoon disasters and casualties are presented below in Figure A-1 and Figure A-2 (Guha-Sapir et al. 2017). As can be seen, the number of typhoon-related disasters continues to increase each year. While increased disaster risk reduction measures are saving lives, typhoons that strike vulnerable locations continue to cause significant loss of life and damage.

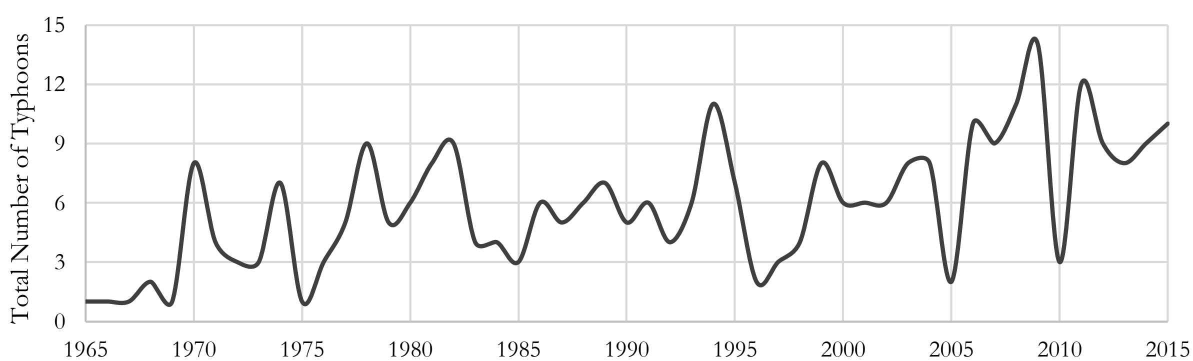

Figure A-1: 50-Year Occurrence of Typhoon Disasters in Philippines

[1] Occurrence of disaster determined used Centre for Research on the Epidemiology of Disasters (CRED) criteria of conforming to at least one of the following criteria: (a) 10 or more people dead; (b) 100 or more people affected; (c) the declaration of a state of emergency; or (d) a call for international assistance.

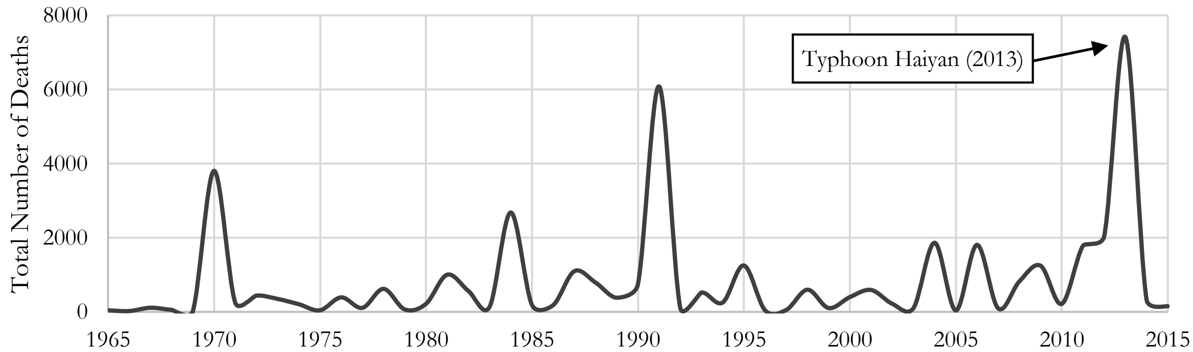

Figure A-2: 50-Year Death Totals from Typhoon Disasters in Philippines

Typhoon Haiyan

On November 8, 2013 Super Typhoon Haiyan, locally known as Yolanda, slammed into the Visayas region of the Philippines. Making landfall in the province of Eastern Samar, the storm had sustained wind speeds of 315 kilometers per hour (195 mph) with gusts up to 380 kilometers per hour (235 mph) – at the time it was the strongest storm ever recorded at landfall, measured by wind speed (Evans 2014). In its wake, the storm left over 6,300 casualties, another 28,000 injured, and affected more than 16 million individuals (NDRRMC 2014).

Over 4 million people were displaced from their homes, more than 1.1 million homes were damaged or destroyed, and the economic impacts were estimated at over $12.9 billion USD (NEDA 2013). This equated to a 4.7% loss of national GDP that year for the Philippines (World Bank 2013). To put the level of damage in perspective, typhoon related damages in the Philippines in 2013 were 1.26 times the previous 50 years of national typhoon damages *combined*[1].

The islands of Leyte and Samar sustained the brunt of the damage, with Tacloban City, Leyte's largest urban center, reporting 90% of infrastructure destroyed shortly after the storm (Center for Excellence in Disaster Management and Humanitarian Assistance 2014).

[1] Analysis of data from Centre for Research on the Epidemiology of Disasters (CRED) EM-DAT.

The Need and Response

In the Shelter Cluster's final analysis of shelter recovery, published in December 2014, organizations were anticipating final shelter support for 344,853 households.[1] The last reported needs assessment was on March 5, 2014 by the Department of Social Welfare and Development (DSWD) and determined support was needed for 1,012,790 households (518,878 partially destroyed and 493,912 totally destroyed) (Shelter Cluster 2014d). This number was reduced from the previously reported target of 1,127,041 households (578,248 partially destroyed and 548,793 totally destroyed) following local government unit (LGU) validation.

Updated Shelter Cluster data on households reached, using secondary sources, shows that an estimated 344,526 households received shelter assistance as of November 2016. Updated numbers of households reached was calculated using current documentation from organizations through a desk review.

This suggests that the last reported humanitarian shelter target of assisting 348,853 households for the Haiyan response was met within 3 years. Note that this number decreased slightly as the response progressed during the first year, but remained mostly static. The final numbers suggest that 99% of planned activities made at the end of the first year following Haiyan were completed. The Shelter Cluster had reporting data for 78 organizations that implemented, or planned to implement, shelter assistance.[2] Five additional organizations were added to this analysis that are included as case studies as they assisted a substantial number of households, but did not report to the Shelter Cluster.

Of the organizations (excluding government agencies) that initially planned to provide shelter assistance for over 1,000 households, 79.5% achieved their initial targets. Of the organizations that

[1] The Shelter Cluster officially closed in October 2014 and became the Humanitarian Shelter Working Group (HSWG).

[2] IFRC Societies were grouped together for analysis because the Philippine Red Cross was an implementing partner for all shelter programs.

initially planned to support less than 1,000 households, only 43.8% achieved their initial targets. 5 of the 83 organizations identified were responsible for filling the unmet targets of the remaining organizations. 4 of these 5 organizations initially planned to provide support for more than 10,000 households. This suggests that humanitarian organizations implementing at scale were the primary driver for sustaining targeted shelter goals.

Despite the ability of shelter organizations to follow through on targets established at the end of the first year, it is worth noting that the total response fell short of its initial target set in December 2013 of supporting 500,000 households (Shelter Cluster 2014a). In total, humanitarian organizations completed about 70% of initial targets set by the Shelter Cluster.

The National Housing Authority (NHA) currently plans to build 205,128 new housing units for affected households at a cost of P61.25 billion. As of November 2016, 29,661 of these units were completed (National Economic and Development Authority 2016). In addition to NHA programs, the Shelter Cluster reported that local government units (LGUs) managed, and completed, 1,360 housing units.

When compared with total shelter needs, humanitarian assistance was able to support 34% of households (initially targeted 50%). Government assistance (aside from the emergency shelter assistance program) is targeting 20% of shelter needs. There is likely some overlap in these targets because some households were assisted by temporary or transitional solutions as well as permanent government resettlement assistance. It is estimated that 62% of households identified in need have not received either humanitarian assistance or government assistance (aside from ESA) to date. A breakdown of shelter targets, and progress as of January 2017, is shown below in Figure A-3 and Figure A-4.

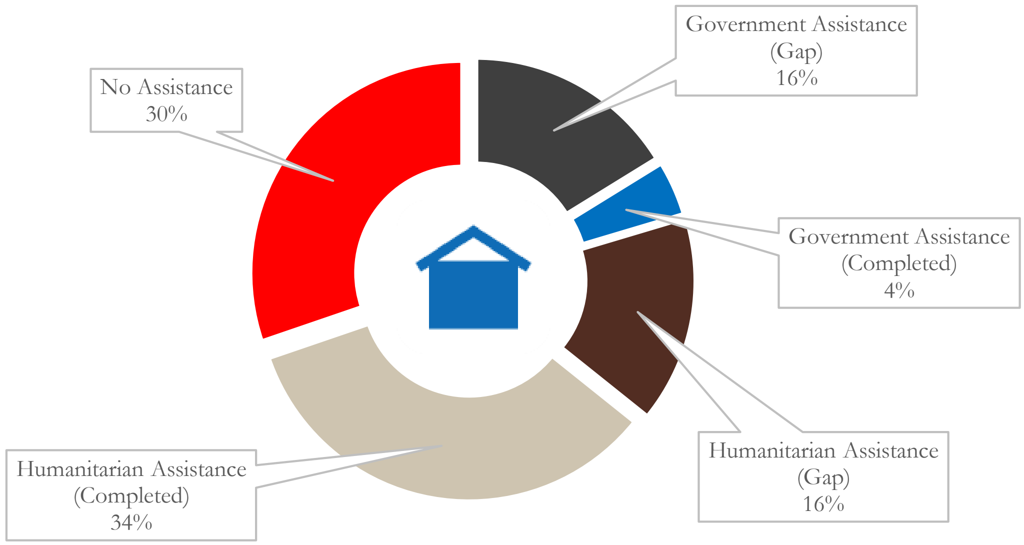

Figure A-3: Breakdown of Current Shelter Implementation Progress[1]

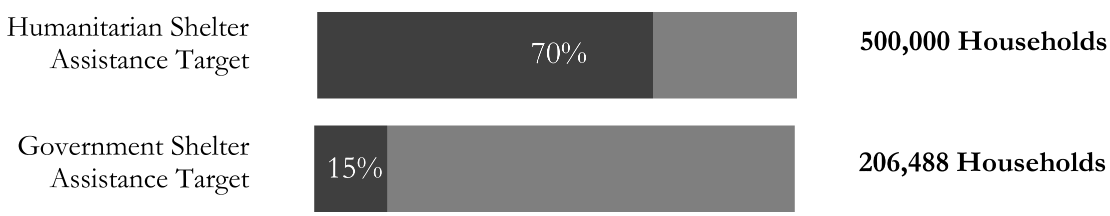

Figure A-4: Humanitarian and Government Shelter Progress as of January 2017

DSWD Emergency Shelter Assistance

While humanitarian shelter assistance and government social housing programs assisted a large number of beneficiaries, DSWD's ESA program was reported to have reached nearly double the number of households as NHA and humanitarian programs combined. Initial targets submitted by DSWD to the Office of the Presidential Assistant for Rehabilitation and Recovery (OPARR) targeted 966,341 households for assistance, totaling P18.65 billion (National Economic and Development Authority 2014).

[1] Note: Emergency Shelter Assistance (ESA) beneficiaries were not included in government assistance as there is inconsistent reporting data and there were a number of discrepancies observed across LGUs. Further, these funds were commonly distributed to households that had already received other shelter assistance in many cases, thus we discuss ESA separately from other humanitarian and government shelter programs. Further, humanitarian gaps

ESA was intended to be used as an unconditional cash grant or material voucher modality. Qualification criteria were outlined by Social Welfare Secretary Corazon Soliman in November 2014 in Memorandum Circular 24 (Soliman 2014). In particular, eligibility criteria were outlined as follows:

> Beneficiaries of the ESA are those families who have no permanent source of income or whose income is below the poverty threshold of the region who may be any of the following:
>
> 1. Families whose houses were either partially or totally damaged located in safe areas or in controlled areas which are already provided with engineering and/or scientific interventions to make it habitable. The Comprehensive Land Use Plan (CLUP) and the multi-hazard maps of LGUs shall be utilized in providing ESA for totally damaged shelter units to ensure that the area is safe from any hazard;
> 2. Families who are renting or sharing houses which are totally or partially damaged provided they are listed in the official DSWD list, sourced through the DSWD-Disaster Family Access Card (DAFAC) submitted by the LGUs as renters or shares of houses within safe or controlled areas;
> 3. Families whose heads are employed in government or private sector but whose term of employment are not permanent or regular basis and do not have access to housing loans of both government and the private sector; and,
> 4. Regular employees of government and private sectors/organizations with fix monthly salary below P15,000.00 shall also be eligible, provided they have not received the same assistance from other agencies and are indicated in the masterlist of beneficiaries in accordance with the DSWD-Disaster Assistance Family Access Card (DAFAC).
> 5. Individual who are considered long survivors due to the untimely demise or the other family members due to the typhoon may also receive the assistance, provided that he/she is among those issued with DSWD-DAFAC and in the masterlist of beneficiaries; and,
> 6. Families listed in items 1-4 already did self-repair of self-reconstruction may be granted the assistance as long as their names are included in the masterlist of beneficiaries sourced through the DSWD-DAFAC.

The program was structured such that funding was distributed to DSWD field offices for distribution. These offices were also responsible for verification of beneficiary criteria and determination of the modality to be used (unconditional cash grant or material voucher).

Despite the program's ambitious targets, distribution of funds was slow and large numbers of affected households reported not receiving ESA. Following DSWD's Disaster Response Assistance and Management Bureau audit of the ESA program in 2016, the lack of communication surrounding inclusion criteria were cited as a primary reason for delays[1]. In particular, field offices reported that they were not consulted regarding the following three disqualification criteria:

1. Households living in danger zones or 'no build zones';
2. Households earning more than P15,000 per month;
3. Households given shelter assistance by other NGOs

These criteria, while well intended, often excluded the most vulnerable households. In particular, vulnerable households were usually the ones living danger zones, such as the 40-meter coastal 'no-build zones.' Further, for those households that had previous assistance from NGOs, there was no recommendation given to differentiate levels of assistance provided. Despite these inefficiencies, the DSWD central office reported that it was able to distribute more funding that initially targeted. As of August 2016, the DSWD central office reported that it had distributed P20.73 billion to assist 1,113,957 households.

The reason ESA is discussed separate from other humanitarian shelter programs and government social housing programs is the sparse documentation available. In many cases, evidence from the field suggests that it was common for households to receive both ESA and NGO shelter assistance, making it impossible to estimate total coverage between both types of assistance. Further, a large number of households did not actually use the cash grant for shelter materials. DSWD's own audit found that it was common for households to 'buy' the ESA of beneficiaries prior to distribution at a lower price. For example, it was common for partially damaged beneficiaries receiving P10,000 to 'sell' their ESA at a rate of P8,000 for immediate cash from a lender and then pay back the full amount upon receiving their ESA payment. Similar phenomena were observed when LGUs used material vouchers.

[1] Department for Social Welfare and Development. (2016). "Where did the Emergency Shelter Assistance (ESA) funds for 'Yolanda' survivors go?" Department for Social Welfare and Development.

While the impact of ESA on shelter is difficult to assess, it was clear that the unconditional cash grants enabled households to prioritize individual needs. Funds were commonly applied for medical expenses, school fees, and livelihood capital. These applications of the ESA program should not be discounted, as they often provided substantial contributions to household recovery.

Shelter Modalities and Approaches

To better understand each case, definitions of shelter classifications are presented below. These definitions are taken from the Shelter Cluster in order to provide uniform comparison of programs. They are taken verbatim from the Recovery Shelter Guidelines published in August 2014 (Shelter Cluster 2014c). Despite clear operational definitions, organizations commonly sought to use more than one modality within a community and thus cases may include more than one classification.

Temporary Shelter Assistance – 2 Years

- **Transitional** – Temporary shelter programs aim to provide safe adequate, appropriate shelter for households whose permanent housing solution is not yet resolved. To ensure a smooth transition on to permanent solutions, transitional shelters are designed to be relocatable, resalable, or reusable, they include risk reducing measures as per the clusters the 8 Build Back Safer Key Messages and ensure access to WASH and cooking facilities though they may not necessarily provide them directly. Transitional shelter programs in higher risk areas must include risk mitigating measures such as preparedness and evacuation plans.
- **Rental Support** – Rental support programs provide temporary support to households choosing to live in a rental property or rented land. These programs may also support landlords to recover their property and open it to the rental market. RS programs are temporary assistance programs, which can support existing rental arrangements or promote rental solutions as an alternative shelter solution. These may include financial, physical or social support separately or jointly to renters and to landlords.

- **Hosting –** Hosting programs are designed to support families choosing to be hosted by another household as a temporary solution, as well as addressing the separate needs of the hosting family. Hosting may provide support to existing sharing arrangements or encourage new sharing arrangements as a temporary option. This may include financial, physical or social assistance including repairs and house extensions. Hosting should remain flexible to address the differing needs and capacities of the hosted and hosting families, whilst respecting the existing, potentially informal, arrangement and ensuring all involved can live in safety and dignity. *(Note: The Shelter Cluster defined Hosting as 'Sharing' – this name is modified to match the classification's common name that occurs in other contexts)*

Permanent Shelter Assistance – 9+ Years

- **Repair & Retrofit** – Repair and Retrofit programs aim to assist households to repair and improve structural resilience of houses to future hazards. R&R programs are divided in Minor and Major depending on the scale of the damage and need of repair, and they may include a combination of cash, material and technical assistance whilst targeting, informal or formal landlords, renters and home owners. Retrofit specifically aims at structurally strengthening existing buildings to withstand future disasters, whereas repairs aim at fixing the damage. In the recovery phase, all repair programs should include retrofitting.
- **Core Shelter** – Core Shelter programs aim to provide households with the core of their future house: one safe room, or the frame of a permanent house with a safe room to inhabit. Core Shelter programs are targeted at households located on permanent sites with security of tenure and the capacity to extend and upgrade in the future. They may include a combination of implementation modalities (direct, indirect, cash, contractor, government or partnership) using materials, cash, labor and technical support as assistance type. Core shelter programs should meet all key shelter principles, parameters and minimum standards.

- **Resettlement** – Resettlement programs aim to assist the affected population through the design and development of new or existing settlements. Resettlement programs are designed to address a broad range of socio-economic and environmental considerations such as access to roads, utilities, community facilities, public transport, livelihoods and other government services. Resettlement programs should be conducted in conjunction with repair & retrofit, core shelters, and permanent housing programs. *(Note: The Shelter Cluster defined Resettlement as 'Settlement Planning & Development – this name was shortened for simplicity.)*

APPENDIX B SHELTER CASES

The programs all provided shelter assistance through formal organizational intervention, however, processes used to achieve reconstruction differed, ranging from emphasis on self-recovery to contractor built housing. For each case presented, information was compiled on the project location, the number of households assisted, and the primary shelter modalities used. The number of households assisted is the final number achieved, not the number planned. Any large discrepancies in unmet targets are discussed within the case profile. The average direct costs of assisting a household are also listed as well as the project duration. In some cases, ranges are listed where different modalities were used, such as both core shelters and repair kits. Note that indirect costs are not listed, as existing data was unavailable. Key themes within each shelter case are highlighted in individual sections. The total time from project initiation to completion is the time listed. This includes time for planning, implementation, and project closeout. A summary of the shelter data is presented below in Figure B-1.

19 shelter cases

266,624 Households assisted by organizations included in selected case projects (77% of total response)

Bounded communities include 3,501 completed shelters (initially 4,211 planned)

Figure B-1: Summary of Shelter Cases Selected for Inclusion

Cases from 3 regions were included in this study. Accordingly, an overview of each region is presented at the start of each section. These summaries provide high level themes in shelter that spanned across projects. A summary table is provided below which lists each case, region, and the modalities used. Excluding government housing programs, the organizations selected provided assistance for 266,624 households, or 77% of all shelter assistance following Haiyan. The cases selected provided direct shelter assistance for 3,501 households (83% of the initial 4,211 households targeted).

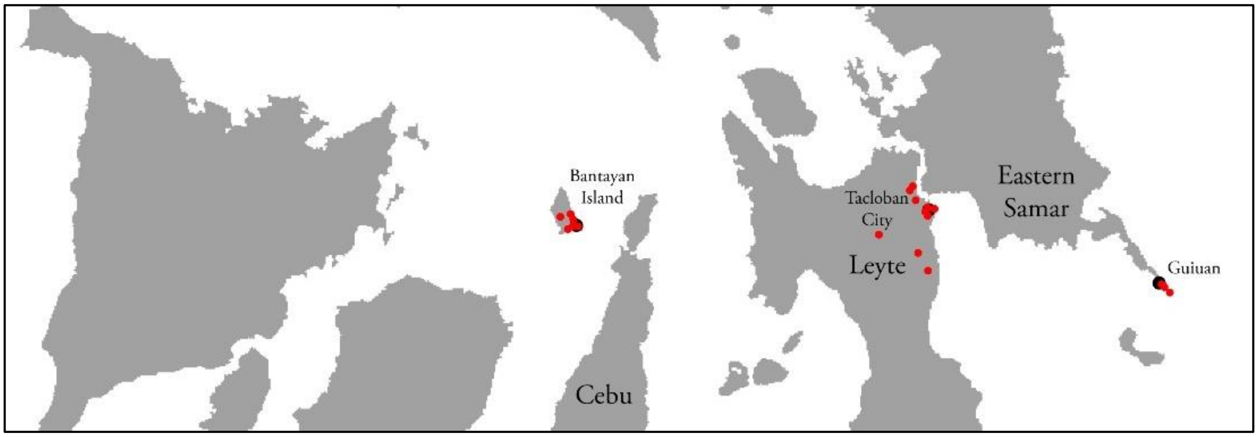

Figure B-2: Map of Shelter Case Sites

Table B-1: Shelter Cases and Modalities

Province	*Shelter Case*	*Repair / Retrofit*	*Transitional Shelter*	*Core Shelter / Progressive Shelter*	*Rental Support*	*Hosting*	*Resettlement*
Cebu	Case 1: Okoy, Santa Fe			X			
	Case 2: Maricaban, Santa Fe						X
	Case 3: Poblacion, Santa Fe			X			X
	Case 4: Sungko, Bantayan	X	X				
	Case 5: Sillon, Bantayan			X			X
	Case 6: Kangkaibe, Bantayan			X			
Leyte	Case 7: Tagpuro, Tacloban		X				
	Case 8: Pago, Tanauan						X
	Case 9: New Kawayan, Tacloban	X					
	Case 10: Bagacay, Tacloban			X			
	Case 11: San Agustin, Jaro			X			
	Case 12: San Jose, Tacloban			X			
	Case 13: Magallanes, Tacloban	X	X	X	X	X	
	Case 14: San Jose, Tacloban	X					
	Case 15: Hiabangan, Dagami	X		X			
	Case 16: Sagkahan, Tacloban	X		X	X	X	
Eastern Samar	Case 17: Sulangan, Guiuan	X		X			
	Case 18: Cogon, Guiuan		X				X
	Case 19: Cantahay, Guiuan			X			

Cebu Overview

While the province of Cebu sustained relatively little damage, municipalities in the north were directly in the path of Haiyan and sustained heavy losses. The Eastern Visayas saw extensive storm surge, however the Central Visayas was fortunate that it was low tide as Haiyan crossed northern Cebu, easing the impact which could have been much worse. Still, the damage was immense and there was a critical need for humanitarian assistance. Despite high need, northern Cebu was largely overlooked for assistance; a result of being overshadowed by the typhoon's limited impact elsewhere in the province. This resulted in fewer organizations reaching the more remote northern municipalities. Aside from its well-known, pristine beaches that attract tourists, Bantayan Island is known for its poultry and eggs which are exported across the Visayas regions. These industries were crippled by Haiyan and while tourism was quickly restored, other livelihoods have been much slower to rebound.

Need and Response

48,757 houses were partially damaged and 61,416 houses were totally damaged in the province of Cebu following Haiyan (Shelter Cluster 2014b). 26,655 households were targeted for shelter assistance by 21 organizations. The 6 cases presented in this section were selected from the municipalities of Bantayan and Santa Fe on Bantayan Island. Of the 110,173 households affected in Cebu, 27,083, or 25%, were located on Bantayan Island directly in the path of the typhoon. Municipalities in the north relied primarily on shelter repair kits, but there was wide ranging diversity in shelter modalities implemented on Bantayan, thus the reason the cases were selected from this context. Further, the isolation of the island, 4 hours' drive from Cebu City to the Port of Hagnaya and then an hour ferry ride to the Port of Santa Fe on Bantayan, made logistics a challenge for organizations delivering shelter support.

Map of Cebu
© Eugene Alvin Villar, 2003

Coordination

Similar to other affected regions, northern Cebu did have a presence of Shelter Cluster representatives, however it's hub was officially located in Cebu City, nearly 5 hours south of where most of the damage was located. Many organizations that deployed in the region were either forced to travel this distance on a weekly basis or position staff away from project sites to maintain coordination efforts. During later stages, coordination meetings for the Humanitarian Shelter Working Group (HSWG) were eventually held on Bantayan Island to better meet the evolving needs of organizations. Involvement in coordination from local municipalities was varied, however there was little government participation in Shelter Cluster coordination efforts. Some municipalities opted to lead coordinating efforts, although this was observed to be parallel to Cluster coordination, while others took a more passive role. In particular, fear of losing support of agencies was expressed as a concern from one government official,

> "We used to go to coordination meetings but it is very tiring to do it because you know they tell you one thing and they are doing a different thing. So it is better that I leave them alone because what can I do? If I tell them the truth, I might hurt their feelings and they might go somewhere else and do the stuff anyway."

These sentiments are valid and future coordination efforts should seek to facilitate more inclusion of local governments into Shelter Cluster planning efforts or adapt coordination structures to fit within existing government efforts to take leadership.

Land Challenges

One of the greatest challenges facing organizations was securing land tenure of households. In 1981, then President Fernand Marcos, issued a proclamation designating key regions of the Philippines as 'wilderness areas' (Marcos 1981). This status was later reinforced by the Philippine senate in 1992 and the Department of Environmental and Natural Resources (DENR) was given oversight (Republic Act No. 7586 1992). The resulting protections meant that despite Bantayan's settlement (population of 136,960), titling of land is rare (Philippine Statistics Authority 2011). This posed a significant challenge for organizations looking to ensure that households would not be forcefully evicted. As highlighted in Case 3 in this section, this became reality in one project's instance within the first 3 years. An interesting approach to this problem is highlighted in Case 4. All 3 municipalities on Bantayan Island have continued to advocate for the ability to issue land titles for residents.

Top: Crab is collected for sale; aside from farming, the sea provides the base of most livelihoods on Bantayan.

Bottom: Tangled steel and rubble are all that remain of a house in Cebu after Haiyan.

Repair & Retrofit | Transitional | **Core/Progressive** | Rental | Hosting | Resettlement

Case 1: Okoy, Santa Fe, Cebu

Overview

Located adjacent to the main the port area of Bantayan Island, and stretching inland to higher ground, Okoy is located in the Municipality of Santa Fe. While the rural population of 3,532 rely on farming and fishing, there are also a number of households who work in services supporting the island's tourism. Similar to other communities on Bantayan, the primary cause of damage was wind and not storm surge. The organization providing shelter assistance in Okoy entered during the early stages and quickly identified the community as having significant shelter and WASH needs.

Map of project location

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230
Households

P90,000
Materials
P16,000
Labor

12
Months

The shelter program aimed to provide families with a single room core shelter, utilizing local contractors for the construction work. Most construction occurred on families' pre-disaster locations, however a large number of houses were moved to new sites within the barangay when land conflicts arose. Beneficiaries were selected by the organization using common vulnerability criteria.

The shelter design included a gable truss roof, a low masonry skirt wall, and hardiflex paneling. A uniform design was used for all beneficiaries, leading to a high level of consistency across the program. Ventilation was improved on the structures by using large windows on several sides, resulting in greater airflow through the structures. Shelters were completed using a direct build approach.

Following the completion of shelter construction, the organization also returned to assist with the construction of latrines. These were both attached, and detached, from the house depending on household needs (elderly, PWD, etc). At least one family member was required to assist with minor construction tasks and the beneficiary was also required to pay for food/snacks for the hired construction labor. These additional expenses accounted for upwards of 20% of labor costs in some cases.

In addition to shelter, the organization also targeted WASH in the community, significantly reducing open defecation rates. Not only was 'hard' infrastructure targeted, but hygiene promotion programs were targeted schools in the community.

Material Selection

While evaluating materials options for shelters, the organization opted for hardiflex, a fiberboard material. The material is significantly more durable than traditional plywood and provides water resistance without the need for painting. While this material increased the cost per shelter, it significantly added to the sustainability of the structures and for many of the beneficiaries, hardiflex was utilized as the material of choice in future additions. At the time of observation, the walling material was holding up better than other shelters where traditional plywood was used. In addition, the organization also opted to use masonry skirt walls to protect against termites and keep water and dirt out of the home. Interior walls were not provided with a grout finish, but most households had applied plaster to interior masonry for additional waterproofing.

Construction Inspections

During construction, the organization relied on engineer inspections for quality control, however a notable feature was the use of a pictorial checklist which was provided to the beneficiary. Using images from the Shelter Cluster 8 Key Messages, this list provided a way for the on-site engineer and homeowner to walk through requirements for the structures. The tool proved to be a successful way for the organization to document the use of safer building practices.

Expansions

Within a year of completion, 63% of households had made major additions, such as rooms or open-air coverings, while another 26% had added partitions or made other interior improvements. Most of these additions used coconut lumber and hardiflex, although some households used masonry construction. These high rates of expansion suggest that the design was adaptable given its simplicity.

Left: Latrines were also included in the construction package offered to beneficiaries.

Right: A beneficiary expanded using similar materials and painted the original structure for aesthetics and maintenance reasons.

Left: An example of a porch added to a core shelter. The beneficiary also painted the original structure.

Right: Another example highlights the variety of materials used for expansions, in this case, the exterior of coconut trees.

Strengths

- ✓ Shelters had excellent ventilation, improved by large windows.
- ✓ Structures were easy to extend and 89% of beneficiaries had expanded within 2 years.
- ✓ Widespread use of information, education and communication (IEC) materials, such as posters and inspection checklists, reinforced safer building principles.
- ✓ WASH program targeted not only latrine construction, but also hygiene promotion in schools.

Challenges and Lessons

- Beneficiaries were asked to provide food for the construction workforce of their shelter, totaling upwards of 20% of labor costs in some cases.
- Contracts were only provided in English, leading many beneficiaries to sign without fulling understanding requirements and expectations; copies printed in the local dialect could have remedied the problem.

Repair & Retrofit | Transitional | Core/Progressive | Rental | Hosting | **Resettlement**

Case 2: Maricaban, Santa Fe, Cebu

Overview

Situated along the highway between the Port of Santa Fe and the Municipality of Bantayan, Maricaban has historically been a fishing community with a population of 2,999. Rising from the sea, much of the community lies at higher elevation, an ideal location for the Municipality of Santa Fe to relocate families affected by the newly enforced 40 meter 'no-build zone' along coastal areas.

Working directly with the municipal government, the organization identified a need for permanent relocation for families across the island that were informal settlers. Planning for the site began within months of Haiyan and site development started in early 2014. The challenge early on quickly became identify land that was usable and accessible. The final site in Maricaban was distanced from the center of Santa Fe's settlement, but deemed accessible given the available options. The largest challenge to emerge was site development. The location's rocky formations and tough soil provided to be a major obstacle for leveling and foundations, requiring extensive heavy equipment. The initial planned number of houses was expected to be 218, but was reduced because of inability to place that number of units on the site. The number was further reduced after more than a year of delays in construction to a final number of 118.

Map of project location

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118
Households

P170,000
Materials
P30,000
Labor

36+
Months

The housing designs featured duplex units constructed of confined masonry with steel channel roof girders. This was developed by the organization's design staff in Manila and was adopted from another site in Tacloban. Latrines were integrated into the back of the unit with a septic tank.

Municipal Partnership

Notably, the project's beneficiary selection was conducted through a municipality-led committee, and targeted families outside of the site's barangay. In partnership with the Municipality of Santa Fe, the organization's role was construction management and design services for the housing units while the municipality was responsible for the management and costs associated with the site development including water, sewer, roads, and drainage.

Despite these early commitments from the municipality, much of the site development had not occurred within 3 years. Water access was provided, although ground conditions made it difficult to link water to each housing unit as initially planned. Electricity was also not available, although the organization was able to later install small solar panels on each housing unit to power two lights. The high number of incomplete houses and low occupancy led to increased vandalism of houses and crime within the site.

Sweat Equity

Approximately half of the houses were funded by foreign donors while the remainder of units were funded by a Philippine foundation. In addition to significant volunteer labor, several contractors were hired to fill labor gaps and perform technical tasks unsuited to volunteers. These labor contributions supplemented the required 400 hours of sweat equity for each family receiving a unit.

One of the major observations of the sweat equity requirement was that women constituted a much higher percent of the labor. This was the result of men being unable to drop other employment which supported the households' basic needs during the transition period. As a result, there was significant lost economic opportunity for women, reinforcing gender pay inequalities.

Livelihood Support

In addition to providing shelter support, the lead organization also provided two different packages for livelihoods. In order to streamline assistance, households were offered either a fishing boat or pedicab (Filipino bicycle with carriage used for local transportation). The absence of other alternatives was prohibitive for many households who previously were not fisherfolks or pedicab drivers. Alternative forms of assistance, such as cash transfers or skills development could have better suited the needs of households.

Left: A housing unit takes shape.

Bottom: Construction of housing using confined masonry provided an exemplar standard.

Strengths

- ✓ The use of confined masonry provided a sense of security for beneficiaries and the houses provide a viable evacuation center for neighboring areas.
- ✓ The duplex design used saved on cost by sharing a central wall.
- ✓ The local government led the beneficiary selection process in collaboration with the shelter organization, leading to greater awareness of long term vulnerabilities that existed within the municipality.

Challenges and Lessons

- Due to the slow pace of turnover and an isolated site, high rates of crime and theft arose.
- Site development proved to be difficult due to large rock formations that were underestimated during the planning phase.
- Raised reinforced concrete floor slabs were required to level structures that were situated on uneven ground, but spans saw excessive deformation and cracking.
- Many beneficiaries complained about poor ventilation of the houses, a result of dark painted roofs and limited breeze at the selected site.
- Sweat equity requirements were commonly fulfilled by women, reinforcing gender pay gap inequalities. Men kept existing paid jobs in order to support basic household expenses, such as food and transportation, during the transition period.

Top: Uncompleted units scatter the site pending completion due to delays.

Middle: Steel girders welded together were used in roofing. In some cases, these were also painted for corrosion protection.

Bottom: Due tough rocky soil, floor slabs needed to be raised, resulting in doors that were often high above the ground.

Repair & Retrofit | Transitional | Core/Progressive | Rental | Hosting | Resettlement

Case 3: Poblacion, Santa Fe, Cebu

Map of project location

© Mike Gonzalez, 2005

40
Households

P90,000
Materials
P2,000
Labor

12
Months

Overview

The community of Poblacion is located in central Santa Fe and home to a population of 2,345. The simple homes stand in stark contrast to the dozens of tourist resorts present nearby. As aid organizations arrived off the nearby ferry it is no surprise that shelter assistance was directed at those in first sight.

Entering into a partnership with the local municipality, one such organization aimed its efforts to support suitable permanent housing. These efforts quickly targeted those affected within the 'no-build zone.' Several initial sites were screened in other neighboring communities before a site was finalized in Poblacion.

As their first time responding to disaster, this small international organization let the municipality guide early decisions on beneficiary and site selection. Aiming to construct houses on a centralized site rather than in-situ, the specific location was chosen from the limited land options available in coordination with the municipality. Most families that were selected through the municipal process lived in Poblacion prior to Haiyan, however some residents were relocated here from neighboring islets. Beneficiaries were allowed to select the specific housing unit they would receive, allowing for placement next to relatives or friends. Interviews with households suggest that this increased social cohesion among those resettled.

Labor Contributions

As least one household member was required to provide a minimal amount of labor each week during early phases to clear the site over a several month period. Several skilled local carpenters were hired to assist with construction in partnership with the international staff and beneficiaries. Most beneficiaries also assisted during construction, however this was not mandatory.

Building Materials

The shelter design featured a single room structure, elevated on concrete footings. Timber and other components (structural connectors) were imported from the United States. While higher quality materials were ensured through this process, both the local government and beneficiaries expressed concern over the cost required to bring in these materials for shelters. Oriented strand board (OSB) panels were used for walling and while these were significantly stronger than locally sourced plywood, most beneficiaries felt that these panels were weaker due to unfamiliarity. The designs developed were also uncommon to most households and there was concern among beneficiaries about whether the flat roof design would withstand high wind speeds, despite the use of manufactured hurricane straps and post straps.

Community Infrastructure

Individual latrines were not provided due to constraints of donor funding. To compensate, three communal latrines were constructed at a central location on the site. No management structures were put in place to maintain these however and households noted that they commonly backed up for up a week, seemingly a result of poor soil conditions. During these periods, open defecation was the norm for most households, unless they had access to another family's latrine nearby. This is particular problematic given the sites sole water source, a well, was located near sanitation facilities.

In addition to communal sanitation facilities, the hallmark of the project was the construction of a large community center adjacent to the shelters. This building was constructed approximately one year after finishing the shelters through additional fundraising efforts from the organization. It is intended to serve as a gathering place for meetings and work place for households.

Land Tenure

While initial land agreements were secured through the municipality, ongoing legal challenges to rightful ownership of the land took place following completion of the shelters. The ongoing dispute highlights an example of the importance of housing, land, and property (HLP) in humanitarian shelter projects, but also points to the uncertainty inherent in these contexts. While the shelter organization approached and received

The completed community center provided additional space for social activities.

Top: An original shelter is shown. Each beneficiary was able to choose their own paint color.

Middle: A beneficiary has expanded, more than doubling the size of the original structure.

Bottom: 3 sets of communal latrines were constructed, although the lack of management has led to infrequent functionality.

approval from the local municipality, future shelter projects should also seek to consult community leadership on any outstanding land disputes. Additionally, documentation of land titles and agreements can be important tools to beneficiaries should future disputes arise.

Despite these concerns, 73% of beneficiaries were able to add another room to their shelter and another 20% made interior improvements, such as partitions, within the first year after handover.

Strengths

- ✓ Allowing beneficiaries to select specific units they would receive allowed for placement next to family members and friends, creating more cohesive clusters of households and social ties.
- ✓ Open spacing between structures allowed for easier expansion and 93% made improvements within the first year.
- ✓ Construction of a community center provided a social gathering place.

Challenges and Lessons

- Imported materials raised costs significantly and unfamiliar design proved difficult to train local carpenters in construction techniques.
- Despite initially secure land agreements, titles were not adequately documented prior to the start of construction, leading to disputes over ownership of the land and uncertainty for households moving forward.

Repair & Retrofit | Transitional | Core/Progressive | Rental | Hosting | Resettlement

Case 4: Sungko, Bantayan, Cebu

Overview

The community of Sungko, with a population of 3,296, lies on the coast of Bantayan Island between the town centers of Santa Fe and Bantayan. Sungko largely consists of families that farm seaweed and crab, relying on the sea for their source of income. The community is rural with a low population density and a majority of households are located on high ground. The average per capita household income is P285 per week – the community is one of the poorest on Bantayan Island, and featured in these case studies.

Given the high poverty rates within Sungko, it was targeted as one of the first communities on Bantayan to receive shelter assistance. Entering to fill a need, shelter assistance arrived from an organization looking to fill gaps in rural areas not covered by other organizations during the early emergency response phase.

Materials and Labor

Providing temporary shelter initially, the organization focused on providing material kits and labor assistance. Material quantities were greater than traditional repair kits as most households surveyed were totally damaged and little remained of previous housing. A fixed design was used for the shelters which included a gable truss roof, coconut lumber members, and plywood walling. Posts were directly buried in the ground without concrete. Labor costs were covered as a part of the shelter package, typically taking less than a day to erect each structure. Shelters were intended to provide immediate protection from the elements while allowing for future expansion as households recovered and gained capital.

Map of project location

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183
Households

P13,000
Materials
P750
Labor

11
Months

Land Rights

One of the most challenging aspects of the program was land rights. Bantayan Island is officially designated as a nature preserve, meaning that much of the land is managed by the Department for Environment and Natural Resources (DENR). There was little recourse to secure land given historically absent land titling processes on Bantayan (see the Cebu Overview for a background on land issues on the island). In place of securing land, this shelter program approached the issues from a different perspective, focusing on the ability of beneficiaries to relocate shelters if future conflicts were to arise.

Design Evolution

Following an initial batch of shelter distributions, designs evolved, eventually leading to a dramatically different structure which included amakan walling, coconut lumber members, and pre-cast concrete foundations. This design integrated other typhoon-resistant design features to improve on the first shelters constructed. A relatively small number (less than 10) were constructed in Sungko, however the designs were used in several other communities later in recovery. The ability to iterate designs in later phases was unique and showcases an effective strategy to improve beneficiary satisfaction as lessons are learned, before waiting for the next response.

One feature that enabled improved living conditions was the use of flared walls, increasing interior space, without increasing floor area and cost. The use of a raised second room added privacy and improved ventilation for the sleeping area. Column posts were specifically designs so that they could be dug up and moved if needed given the complex land rights of the island. Connections could also easily be removed, relying on two steel plates and bolts to connect the shelter posts and foundations. In place of embedding steel plates, bolt holes were precast into footings using pipe sleeves.

Top: Initial temporary shelter package that was provided to households. Storage areas were commonly added for seaweed and crab livelihoods.

Middle: Within the first year, most family had added an additional room or living area, however these often lacked any flooring material.

Bottom: A second phase shelter featuring design elements taken from early lessons is shown.

Top: Trusses used metal straps for improved strength and rafters were tied to trusses using steel wire, in addition to cleats.

Middle: Example beneficiary timber expansion.

Bottom: Example of beneficiary who has expanded to the structure using masonry.

Strengths

- ✓ The use of locally available building materials was cheaper than tent distributions and injected cash into the local economy during the emergency phase.
- ✓ Rather than keep designs static, the organization chose to radically alter shelters during a second phase of implementation, including removable foundations that could be moved in the event of land conflicts.
- ✓ Lightweight materials were easy to reuse in later expansions.

Challenges and Lessons

- Early temporary shelter excluded many households from receiving other shelter assistance from organizations and the government in later stages of recovery.
- Initially the shelter sizes did not meet Sphere standards and while they were acceptable for short term use, provided inadequate long term living space.
- Lack of concrete foundations and raised walls/columns in early shelter designs resulted in rapid deterioration of coconut lumber and wall materials from weathering and terminates.

Repair & Retrofit | Transitional | **Core/Progressive** | Rental | Hosting | **Resettlement**

Case 5: Sillon, Bantayan, Cebu

Map of project location

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75
Households

P86,000
Materials
P17,000
Labor

11
Months

Overview

Sillon, with a population of 4,064, is a fishing community located north of the port in Santa Fe. Its economy is largely based on farming and fishing, similar to other neighboring communities. During the emergency response phase, a large number of single mother households were identified for shelter assistance in the community. These households were identified for emergency shelter, such as tents and tarps, and subsequently targeted for receiving relocation assistance following the LGU's enforcement of the 'no-build zone.'

Having worked closely with households during early emergency phases, the organization was able to closely monitor households recovering at slower rates. Criteria for selection were based on Shelter Cluster guidance, however women and children were singled out for assistance.

Designs were developed for core shelters, providing a safe, permanent home, while allowing for future expansion. The final design featured a half height masonry skirt wall with coconut lumber and plywood walling, adapted from past designs implemented in the Philippines. Roofs were designed with the 'quatro aquas' style (hipped) to reduce wind loads on the structures. The project was phased such that all of the shelters were first completed and latrines were later added to the units. Septic tanks were shared between units to reduce on costs. Communal toilets were provided on-site for the turnover of shelters while construction permanent, individual latrines were ongoing. These were attached to the structure with access from the outside.

Services

In addition to shelter, a daycare center was built adjacent to the site by a Cebu-based foundation with a specialty in education facilities. This was particularly impactful given the high concentration of single mothers that were selected for the relocation site. Despite this service, other infrastructure such as water and electrical connections that were initially committed by the LGU were not constructed. A single electrical connection was present and water available at well points was 15-20 minutes by walking.

Vulnerability

The organization targeted the most vulnerable groups for relocation, resulting in the selection of mostly single mothers and children. Prior to Haiyan, the majority of households were employed in household services, as clothes washing and food preparation. Few livelihood opportunities were present at the new site, given its distance from other settlements and households in the community. The most common livelihood observed for relocated beneficiaries was crushing of stone for other infrastructure projects on the island. This work was physically demanding at low wages. The distancing of these vulnerable groups from previous settlements was observed to compound vulnerabilities by isolating and concentrating them in a single site. As a result, there were low occupancy of shelters and many households opted to return to coastal areas where greater income opportunities existed.

Strengths

- ✓ Provided safe location that was on higher ground, away from coastal area prone to storm surge.
- ✓ Designs incorporated 1-meter high masonry skirt wall to protect against terminates and keep elements out of shelter interior.
- ✓ Daycare center provided large number of single mothers selected as beneficiaries the ability to seek income during the day.

Challenges and Lessons

- Removal from coastal areas to an isolated site resulted in disconnecting households from social and economic ties, resulting in many households returning to live in make-shift shelters along the coast either for part of the day, or permanently.
- The relocation, and concentration, of vulnerable groups exacerbated risks, whereas these households relied on neighbors for support previously.
- Despite being marketed as 'core shelters' that were expandable, little space was provided between and behind shelters to make expansions and improvements.

Top: While some beneficiaries initiated investments in opening sari-sari stores on the front of their shelters, most were unable to find work at the new site.

Bottom: The construction of a daycare adjacent to the relocation site allowed women to seek income during the day.

Repair & Retrofit | Transitional | Core/Progressive | Rental | Hosting | Resettlement

Case 6: Kangkaibe, Bantayan, Cebu

Overview

Kangkaibe is one of the largest geographic communities on Bantayan Island and covers a vast area inland. With a population of 2,635, most households farm for their livelihood, however a quarry located in the community provides income for other households to process this rock through laborious hand techniques.

3 organizations were providing shelter assistance in Kangkaibe at various stages of recovery. The largest of the 3 programs focused on core shelters. Starting with assessments conducted by community volunteers, the first phase of construction started within 6 months of Haiyan.

Following completion of the first batch of beneficiary households, a second batch commenced in early 2015. The shelter design, constructed from coconut lumber and corrugated galvanized iron (CGI) sheets, has a spacious interior that allowed for a partition to be added by households later. The structure was also raised on pedestal footings to protect from termites and solignum, a weatherproofing compound, was added to exterior walls during the second phase.

Map of project location

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348
Households

P5,000-P70,000
Materials
P0-P14,000
Labor

18
Months

WASH was intended to be integrated from the start of the program, however the priority placed on shelter needs delayed the start of WASH assistance. Labor was provided by organization-hired local contractors; however, many beneficiaries assisted with small construction tasks. A formal training program through the Technical Education and Skills Development Authority (TESDA) was provided for approximately 50 carpenters early in the program. Several other NGOs had provided temporary solutions to beneficiaries prior to the organization entering.

Livelihoods

Linking livelihoods assistance to the shelter program proved to have a significant impact on households' incomes. In particular, livestock and farming seed were distributed in order to support household economic recovery. The distribution of livestock in particular was effective. In the absence of savings, many households commented that they would not have been able to buy the needed seed their annual crop.

Duplication and Minimum Standards

While evidence from past disasters suggest that duplication of beneficiaries was unintentional, this case highlights an example of where misaligned strategy actually was the underlying cause of duplication. For one household, all 3 shelter organizations working in the community provided them with shelter assistance, each organization determining that the previous shelter was inadequate. While it is promising to see that these organizations recognized the potential inadequacy of living conditions and opted to still include these households in beneficiary selection, it is troubling to see that upgrades or adaptations were not made to previous structures and instead entirely new structures were constructed. Future efforts to meet Sphere standards for household should recognize repair & retrofit options in these cases.

Strengths

- ✓ Complementary livelihood program, in particular livestock, was able to boost income for households and enable transition to long term recovery.
- ✓ Weatherproofing and protection measures, including solignum coating of walls, used motor oil coating of lower posts, and raised concrete footings, were found to be an effective combination in limiting termite damage.
- ✓ Shelters were well ventilated and provided large livable space.
- ✓ Labor rates were 'pakyaw' contracts, or fixed rate per shelter, leading to faster completion rates of shelters by labor teams.

Challenges and Lessons

- Duplication of beneficiaries was observed to be intentional rather than accidental, the result of lacking minimum shelter standards from previous shelter assistance, however no attempts were made to upgrade or adapt previous shelters.
- While typhoon hazards were the primary concern in planning for resilient livelihoods, a drought stressed farming income during recovery, highlighting the importance of livelihood diversification.

Top: Termite and weathering protection included the use of solignum, a chemical protectant, that was applied to amakan walls. Used motor oil was also applied to posts for protection.

Bottom: Interiors were spacious, allowing beneficiaries to place partitions to fit individual household needs.

Leyte Overview

Situated in the Eastern Visayas, the province of Leyte sustained some of the worst damage from Haiyan. High tide, and amplification of storm surge within the Gulf of Leyte, brought towering waves to the urban center of Tacloban and its neighboring coastal communities. Inland communities were also affected by significant agriculture and economic losses. In total, 79% of all casualties from Haiyan were in Leyte (NDRRMC 2014).

Prior to Haiyan, Tacloban was known as a rising city and is one of 33 'highly urbanized cities' (HUCs), the largest urban settlements within the Philippine (Philippine Statistics Authority 2017a). The Philippine National Highway cuts through Leyte, and Tacloban City, and a large amount of goods flow through the province. The urban center is known for its thriving trade and commerce, including agriculture, construction, banking, outsourcing services, education, transportation, and tourism.

Need and Response

191,230 houses were partially damaged and 230,407 houses were totally damaged in the province of Leyte following Haiyan (Shelter Cluster 2014b). 133,988 households were targeted for shelter assistance by 33 organizations. Of the 421,637 households affected in Leyte, 58,423, or 14%, were located in Tacloban City. The 10 cases presented in this section were selected from across the province of Leyte. While a number of cases included are within Tacloban, other rural cases are presented outside to cover the wide scope of activities that were conducted in the aftermath of Haiyan. While urban centers, such as Tacloban City, were the media focus of the Haiyan response, 80% of affected households within 50 km of the storm path were in rural areas (REACH 2014).

Map of Leyte

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Coordination

As the central hub of coordination, Leyte, and more directly Tacloban, became known as ground zero for responding organizations. Many of the Shelter Cluster staff were based here and organizations gravitated toward Tacloban participate in sector discussions of strategy and direction. In addition to formal coordination, the role of information coordination was equally important. Cluster meetings may have been the face of coordination, but evening gatherings at social venues in Tacloban facilitated meaningful connections and partnerships between organizations.

The city of Tacloban estimated that there were **13,297 informal settler households** prior to Haiyan, mostly along coastal areas.

Resettlement

Faced with the alternatives to reduce future disaster risk in the days following Haiyan, the City of Tacloban made the hard decision to relocate a sizeable percent of its population to land less prone to storm surge. In partnership with UN-Habitat, the local government released the Tacloban Recovery and Rehabilitation Plan (TRRP) in May 2014, outlining plans for the resettlement of between 6,844 and 11,494 households (City Government of Tacloban 2014). This movement of nearly 20% of Tacloban's 221,174 population, has become a focal point of the Haiyan response and continues to build on humanitarian shelter assistance provided.

Bottom: The city of Tacloban estimated that there were 13,297 informal settler households prior to Haiyan, mostly along coastal areas.

Left: A ship remains grounded in Tacloban, washed ashore during the rising storm surge.

Right: Damage to one of Tacloban's shopping center.

Repair & Retrofit | Transitional | Core/Progressive | Rental | Hosting | Resettlement

Case 7: Tagpuro, Tacloban, Leyte

Overview

One of the hardest hit areas of Tacloban City was San Jose. Stretching out into the Gulf of Leyte on low ground, the area was inundated with storm surge during Haiyan. Its vulnerable location, along with political pushback to long standing informal settlement, led the city to seek relocation for households in San Jose.

The Tagpuro transitional site was started, in part, due to rising political pressure to accelerate the speed of reconstruction and relocation planned within Tacloban. The site in Tagpuro (population 677 before Haiyan) was one of the first projects to develop land in northern plots of the city. The project was initialized through the collaboration of 3 organizations in partnership with the Tacloban City Housing Office.

The shelters were intended to be used for a two-year period to transition relocation of families from coastal areas of Tacloban City to other permanent resettlement in the north. As permanent housing was constructed in the neighboring area, families were intended to leave the transitional site and move into relocation housing constructed by government agencies and other NGOs. In theory,

Map of project location

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86
Households

P45,000
Materials
P30,000
Labor

4
Months

additional families would then move into the transitional shelters, beginning a new cycle. Families were anticipated to stay between 2 to 6 months at the transitional site.

An agreement was formed between the landowner and city for a 2-year period, at which point the shelters were supposed to be turned over the landowner for private rental and use. Construction of the 86 shelters took 5 weeks starting in August 2014. Shelters were constructed using coconut lumber, amakan

(woven thatch) walls and nipa (palm leave) roofing. Design and construction of the structures used light materials as the transitional site was expected to only require a short life span. The Department for Social Welfare and Development (DSWD) was responsible for selecting and moving families from San Jose.

WASH

One of the challenges of the site was access to potable water. The City of Tacloban was required to truck in potable and non-potable water, delivery of which was noted as inconsistent. Expected water deliveries were supposed to occur 4 days per week, but 3 days was more common. While sufficient water was available for cooking, there were consistent shortages of washing and bathing water.

Left: Communal latrines were installed at the transitional site, however maintenance responsibilities were not addressed and several of the septic tanks had filled without being desludged within a year.

Right: Without available fresh water nearby, the City of Tacloban trucked water to the site; many beneficiaries expressed that deliveries are inconsistent.

Bottom: In the background, permanent houses rise nearby the transitional site.

Communal toilets were constructed concurrently to shelters by a partner organization. The lack of attendance to establishing management and responsibilities for these has led to deterioration of toilets and nearly half had clogged within a year of use, resulting in open defecation practices.

Education and Livelihoods

The location of the transitional site nearly an hour from beneficiaries' original communities was the largest stress on households' access to services and livelihoods. In most cases, households noted that they were paying as much as 50% of income on travel expenses to send their children to schools near their old community or to return to economic opportunities within the city. While some schools existed near the transitional site, most households preferred to send their children to their previous school, particularly given that transitions occurred in the middle of the school year. Transitions to new schools in the north seemed to see increased enrollment rates after the start of a new school year.

Uncertainty and Relocation

Despite planning efforts, stalls in permanent construction left many families in the transitional shelters for over a year. This unduly stressed households, resulting in many returning to poor shelter conditions in their original community while permanent homes were constructed. Confounding lacking services was poor communication to beneficiaries as to when completion of permanent houses was expected. Greater transparency in resettlements processes was a major barrier to sustainably transferring households.

Strengths

- ✓ Use of amakan for walling and nipa for roofing provided excellent ventilation for shelters.
- ✓ Design of shelters were robust, including large concrete footings used to level structures on slopes and difficult site conditions.
- ✓ Establishment of transitional site management group advocated for rights of households with local government and assisted with incoming households being relocated to the site.

Challenges and Lessons

- The site lacked access to supporting infrastructure, such as water and electrical systems, and was distanced from other services, such as schools and livelihoods.
- Land tenure agreements and shelters were not initially planned to be used beyond 2 years; delays in permanent construction suggest their use for 5+ years.
- Few of the households at the transitional site knew each other before and were from different communities, resulting in limited social cohesion.

Top: Most fisherfolk within the transitional site preferred to return to their original community because of unfamiliar fishing grounds near the transitional site.

Bottom: Difficult site conditions were overcome through the use of raise concrete footings to level the shelter floors.

Repair & Retrofit | Transitional | Core/Progressive | Rental | Hosting | **Resettlement**

Case 8: Pago, Tanauan, Leyte

Overview

The coastal community of San Roque in Tanauan was left with nothing in the aftermath of Haiyan. Residents not living with 40 meters of the coast were allowed to return, but dozens of families were unable to return to the 'no-build zone,' and without anywhere to go, formed a tent city. During these early stages, the local government deemed these households a priority for shelter support given their inability to resettle previous land. This led to a public-private partnership between a government agency and NGO, who were able to eventually identify land inland in the community of Pago (population 917 before Haiyan).

Land at the relocation site was purchased from the municipality by the organization for the project and the government began site development shortly thereafter with ground breaking in March of 2014. The NGO's role on the project involved community organizing and mobilization. Designs were developed based off of existing National Housing Authority (NHA) row house plans. The interior was designed to accommodate future expansion of a lofted second floor with a single

Map of project location

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365
Households

P165,000
Materials
P35,000
Labor

36
Months

reinforced concrete beam across the center of the units. A raffle was used to decide exact units that were given to beneficiaries. Toilets and septic tanks were included inside the provided housing units. Access to potable water was accessible through several wells, however there were concerns over groundwater contamination. The process of land titling for each household had not taken place within 3 years and concern was expressed by many beneficiaries whether, and how, this would occur.

Sweat Equity

Notably, beneficiaries were required to contribute 1,500 labor hours to the project before final handover. This only included unskilled labor and skilled tasks were left to contracted labor. In addition, residents were required to go through a 'value formation' training, which focused on instilling a sense of community and covered maintenance.

Relocation and Livelihoods

Despite mitigating storm surge risks, few new livelihoods were available for those households relocated. As fisherfolk, this meant that many had to travel far to reach their previous community of San Roque. As a result, most households were maintaining a shelter along the coast to store fishing equipment. In some cases, the new housing units were used infrequently because of this separation.

Strengths

- ✓ Organization provided 'values' training, which focused on community cohesion and skills, such as savings, to support long term maintenance of housing.
- ✓ Housing shell used reinforced concrete beam for second floor, allowing beneficiaries to expand at later date using more cost effective timber flooring.

Challenges and Lessons

- While the selected site removed the risk of storm surge from households previously located in coastal areas, the new location is prone to flooding.
- A majority of households were previously fisherfolk and the relocation to an inland site meant that many households maintained a second shelter along the coast in order to maintain their livelihood; no attempts were made to provide alternative livelihoods for those relocated.
- Use of contractor-built housing model resulted in poor construction quality in a number of units with little recourse for beneficiaries.
- Despite poor contractor construction quality, the regular involvement of beneficiaries on-site led to the recognition of construction flaws; future programs should seek to provide avenues for beneficiaries to report these claims and correct defects.

Top: Construction begins on housing units.

Middle: Colorful designs spot the project site.

Bottom: A beneficiary has added a second floor using remnants of their previous house and from a previously received shelter repair kit.

Repair & Retrofit | Transitional | Core/Progressive | Rental | Hosting | Resettlement

Case 9: New Kawayan, Tacloban, Leyte

Overview

New Kawayan's population of 543 was Tacloban's smallest community prior to Haiyan. Still within Tacloban's city limits, this rural farming community stands in stark contrast to the busy urban center of the city. The community is quickly changing with the extensive development plans for Tacloban's northern communities. Parts of New Kawayan have been marked as sites for permanent resettlement.

While other efforts focused on shelter and settlement for new relocation sites, there was also support aimed at providing self-recovery assistance to households in the existing community. This support aimed to repair and retrofit existing structures that survived Haiyan and provide sufficient materials for limited new construction. The assistance consisted of material distributions with assisted labor. Three packages of materials, composed of different quantities, were provided to homeowners as assistance starting in October 2014.

In early stages of planning households complained of potentially unfair distribution of assistance, leading the organization to provide

Map of project location

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148
Households

P2,400-P13,100
Materials
P800
Labor

7
Months

blanket coverage to all households, regardless of income or damage. The determination of which package each household received was decided by the organization based on damage and family income. Labor for the project was provided by local carpenters hired through the organization at a fixed rate of P800 per shelter repair. Households were free to use the provided materials in any manner so long as they adhered to the Shelter Cluster '8 key messages,' a check that was performed by the organization in early December 2014.

Material packages with fewer items were commonly used to extend houses. Intermediate packages were most frequently used for roofing repairs and minor walling, while the largest package was used for new construction. The materials included nails, corrugated galvanized iron (CGI) sheets, several coconut members, and plywood. In place of using sawn coconut members for posts, most households opted to reuse hardwood timber. As concrete was not included, posts were typically buried 1 meter into the ground for stability.

Training

A one-day training on building practices led by the organization was provided to hired carpenters. Any household members were able to participate, and approximately 20 individual attended the training. In order to demonstrate concepts, the organization demonstrated skills on a scale model.

Scale model used to demonstration key messages for safer building construction.

Those that received training were then eligible to be hired for labor to install materials for each beneficiary household. The fixed cost of labor per household and initially large number of laborers led to most individuals dropping out of the program due to low wages. Those that were retained also complained that the wages provided later remained sub-standard. While fixed cost rates per shelter were observed to be successful in other programs, low rates were one reason attributed to low retention of trained labor in this case.

Self-Recovery

A notable outcome of the shelter program was the impact of allowing households to self-select priorities. In particular, households were observed to have higher savings, even though incomes levels were one of the lowest of any communities studied. This can in part be attributed to the ability of households to better control shelter construction costs and is promising for future responses.

Materials were used for variety of purposes suited to the needs of each household.

Strengths

- ✓ Training program used active demonstration to show safer building concepts using a scale model.
- ✓ Blanket coverage of 3 packages of shelter repair kits reduced conflicts of beneficiary selection and better fit individual needs.
- ✓ Despite having low incomes, households had some of the highest savings, attributed in part to control over prioritizing individual recovery needs.

Challenges and Lessons

- Labor teams were paid per house (P800) and carpenters voiced that this resulted in sub-standard wage rates.
- Initial material quantities fit most household needs, but could have been adapted for more vulnerable households with senior citizens or persons with disabilities (PWDs)

Repair & Retrofit | Transitional | Core/Progressive | Rental | Hosting | Resettlement

Case 10: Bagacay, Tacloban, Leyte

Overview

The community of Bagacay, with a population of 3,936 is located north of Tacloban City, adjacent to the Philippine National Highway. Part of the community lies in a low lying area prone to storm surge while the other parts of the community lie on higher ground. This disparity in hazards places those near the coast at much higher risk, however land scarcity with the community meant that relocation options were not viable.

The shelter assistance program for Bagacay began in November 2014. Beneficiary selection used standard vulnerability criteria however the organization required that beneficiaries either own or could purchase land that was at least 30m². In the event that a beneficiary could not obtain land, they were excluded from shelter assistance. While this policy ensured that households would not be evicted from newly constructed core shelters, it also was unable to target some of the poorest households in the community who lacked land.

Designed as a core shelter, the organization used an existing design that had been applied by its shelter assistance programs for more than a decade in the Philippines. The design featured concrete columns, a masonry skirt wall, and plywood walling. The large interiors were well suited to future addition of partitions and the place of doors and windows enabled easy expansion on to the front and back of shelters. Toilets and septic tanks were integrated into each shelter design; however, a kitchen area was not. Kitchens were usually the first expansions observed. A training on safe housing construction and disaster risk reduction was conducted for all beneficiaries on a weekly basis before the start of construction.

Map of project location

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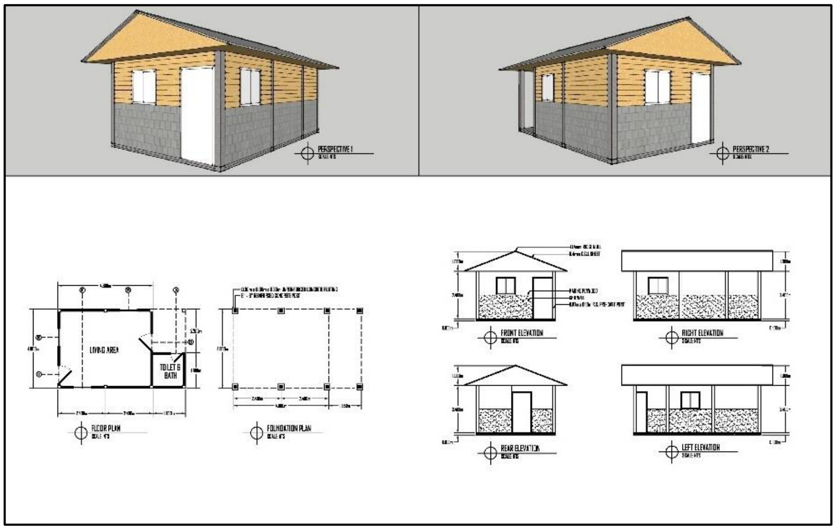
150
Households

P100,000
Materials
P20,000
Labor

7
Months



The core shelter design used a masonry skit wall with timber frame, providing added strength with reduced cost.

Materials and Labor

Materials were procured and delivered to site by the organization. Each beneficiary was responsible for inspecting materials upon receiving. Due to labor backlogs, it was common for materials to sit for several weeks before construction could begin on a beneficiary's shelter. This resulted in some materials being damaged due to poor storage or theft prior to installation. Future efforts to use centralized material distribution should stagger material deliveries to more closely align with construction start dates or provide tarps and other measures to protect materials.

Labor was hired using 'pakyaw' (fixed rate) contracts. A 10-day limit was placed on labor at which point the beneficiary assumed all labor costs in the event that shelter was not completed. Changes to the configuration were not permitted before or immediately after construction. In a number of cases, the 10-day labor limit was unable to finish the core shelter and beneficiaries were left to cover any remaining costs.

Strengths

- ✓ Masonry skirt wall and painted plywood greatly increased the durability of shelters.
- ✓ Extensive beneficiary training on safer building practices was offered prior to construction to transfer knowledge.
- ✓ Shelters used precast concrete columns in place of timber for columns; mitigating termite concerns.

Challenges and Lessons

- Beneficiaries expressed that the materials delivered were often insufficient to complete entire core shelter to specifications and that the allowed number of labor days (10 days) was too short for completion.
- Materials were often delivered too far in advance of construction and many beneficiaries failed to protect materials, leading to damage before installation.
- Beneficiaries were required to have a 30m^2 land plot for shelter, which often excluded the most vulnerable within the community.

A completed core shelter after completion.

Repair & Retrofit | Transitional | Core/Progressive | Rental | Hosting | Resettlement

Case 11: San Agustin, Jaro, Leyte

Overview

Lying inland in Leyte, San Agustin's population of 824 is located in the municipality of Jaro. Farming is the predominant livelihood and few other livelihood opportunities previously existed in this remote mountain community. The greater distance inland meant that the community received little early assistance from the government or organizations. Poor roads and frequently washed out bridges regularly disconnect the community from services and goods.

Following shelter assistance in other communities in Jaro, the organization entered to provide shelter support for San Agustin. Opting to provide core shelters, coconut lumber was selected as the most readily available material. Difficult access and cost of transportation were deciding factors in selecting coconut lumber for shelter designs.

Designs were developed from an earlier recovery project in another barangay in Jaro. The shelters featured large covered porches, and extended roofing to allow for significant open air covered spaces. To protect from weathering and termites, paint was provided, although not sufficient to cover the entire

Map of project location

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45
Households

P80,000
Materials
P20,000
Labor

9
Months

shelter. The organization selected to use vertical or horizontal timber planks for exterior walls. This was found to significantly improve the weatherproofing and proved better protection from rain over other alternatives such as amakan (woven thatch) or plywood. In comparison to other shelter assistance, the structures were much larger for household sizes, and several beneficiaries noted that they would plan to downsize the structures as future maintenance was required, in place to replacing elements due to cost constraints.

All labor costs for the houses were covered by the organization, however beneficiaries were required to dig the pit for the provided septic tank included with shelters.

Construction of shelter walls.

Training and Certification

Carpenters used for construction were hired from multiple communities within the municipality. In partnership with the Philippine Technical Education and Skills Development Authority (TESDA), the organization covered each laborer's NC-II carpenter's certification. This training program was field based, allowing workers to build shelters while being overseen by a TESDA representative. In comparison to other training programs offered through NGOs, the NC-II certification is universally recognized across the Philippines (and internationally in some countries), allowing those that participated the ability to have demonstrated competencies for future work. This was shown to be of the one most effective components of the shelter program and one of the few that opted to partner with the Philippine government for certifications.

Strengths

- ✓ Use of coconut lumber planks for siding proved to keep water out better than plywood or amakan alternatives.
- ✓ Paint provided to beneficiaries allowed for more aesthetically pleasing structures and protected coconut lumber.
- ✓ Training program worked through TESDA in order to issue NC-II carpentry certificate that was universally recognized within the Philippines.

Challenges and Lessons

- Timber posts were embedded in concrete, making their replacement difficult; straps or other connections could have better enabled replacement of worn posts in the future.
- While latrines were attached in to the core shelters, coconut lumber was used for the walling materials which deteriorated more rapidly due to washing and bathing water.

The incorporation of covered, open air spaces into shelter designs allowed for more livable conditions that increased beneficiary satisfaction.

Repair & Retrofit | Transitional | Core/Progressive | Rental | Hosting | Resettlement

Case 12: San Jose, Tacloban, Leyte

Overview

Situated in a densely populated neighborhood of Tacloban, San Jose lies adjacent to the coast. The 2,548 population of barangay 83C were at the center of the most severe damage, but one of the last communities within Tacloban to be reached by shelter assistance. Unlike other communities in Tacloban, none of the households were targeted for relocation. 3 NGOs entered to provide shelter support, each targeting different puroks, or neighborhoods, within the community. This case will discuss one of these three organizations and their approach to shelter.

Map of project location

42
Households

P80,000
Materials
P20,000
Labor

11
Months

Planning for the project started in late 2014 and construction on the first homes began in December, just over a year after Haiyan. While labeled core shelters, the approach sought to provide permanent housing solutions for households. Shelter designs were adapted from transitional shelters built in northern sites by the organization earlier in the recovery phase. Additional hazard resistant design features such as strapping and increase member sizes were included to improve the expected lifespan of shelters. Two designs, a single story and two story model, were used. The two story shelter was used in instances where insufficient land was available. Single story shelters were provided for households that had larger plots, or households that were unable to use stairs on a regular basis, such as elderly and persons with disabilities (PWDs). All of the shelters were constructed through a direct build approach and beneficiaries were not required to participate during construction.

A Volunteer Model

Labor was provided through a combination of foreign volunteers and local skilled carpenters.

Tasks requiring more technical knowledge and at height, such as roofing, were completed by local labor. Foundation work, framing, and other site tasks were completed by volunteers. Close interactions between beneficiaries and volunteers resulted in strong relationships and trust between the organization and beneficiaries. Despite these benefits, many households that were not selected expressed concerns over the intrusion of a large number of international volunteers and noted that there was a sense of bias in support, reinforced by the extensive attention given to those selected. Organizations using a volunteer model should be acutely aware of the implications of using a disparity in assistance with communities and should seek to promote strong relationships with households not selected as beneficiaries.

Strengths

- ✓ Two story structures were well suited to urban context given limited land availability and protected household items against regular flooding.
- ✓ Time and investment of volunteers built strong relationship between organization and beneficiaries.

Challenges and Lessons

- Beneficiary selection process did not survey all households within the community and transparency of selection could have reduced number of conflicts.
- Use of double walling (interior and exterior) in urban environment led to rodents within walling.
- Speed of construction was limited by linear progression of shelter construction and number of skilled labor and volunteers.

Top: Two story shelters provided additional protection against perennial flooding.

Middle: Alternative single story shelter for vulnerable households, such as elderly and PWDs.

Bottom: Shelters included extensive concrete foundations to support overturning forces of wind

Repair & Retrofit	Transitional	Core/Progressive	Rental	Hosting	Resettlement

Case 13: Magallanes, Tacloban, Leyte

Overview

Composed of mostly fisherfolk and fish vendors, Magallanes is located along a coastal belt in Tacloban City. With approximately half of the community's population of 1,304 (barangay 52) falling in the declared 40 meter 'no-build zone' along the coast, households were left with an uncertain future in the aftermath of Haiyan. A large percentage of the residents were targeted for future relocation to north of Tacloban City, however dates of transfer were highly uncertain. Further, others within the community were allowed to stay, but still had significant shelter needs.

The organization's shelter program sought to tackle these complex, and unique, shelter needs through multiple modalities including renting, hosting, repair & retrofit, and new construction. The option of which modality to use was based on land tenure, damage to the previous house, but also notably allowed beneficiaries to select the best option for their needs. Beneficiaries were also allowed to choose between direct build assistance and cash transfers. Cash transfers were completed through Palawan Express – a local money transfer agency. In total 88% of beneficiaries

Map of project location

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199
Households

P18,000-P72,000
Materials
P0-P20,000
Labor

18
Months

opted for cash transfers. Both those selecting direct build and cash transfers, said that they felt the delivery method was best suited to their needs.

In-Situ Building

For households located in the build zone, 4 cash transfer packages were offered: totally damaged, major damage, minor damage, and roof sheet repair only. While the evaluation criteria were different for these four categories, the assistance provided was based on two packages. Major damage and totally damaged households received the same value of assistance, while minor damage and households with only roof repairs received the same value of assistance. These are shown below.

Summary of Shelter Assistance Categories.

	Major damage	Minor damage
Tranche 1	P16,500	P10,000 +CGI
Tranche 2	P13,100 +CGI	P10,000
Tranche 3	3,400	Not applicable

CGI sheets were provided directly to households as quality material could not be found locally and had to be imported from other regions during early stages of recovery. For each level of assistance, 20 CGI sheets were provided along with 2 plain steel sheets.

A tranche approach was used to ensure that beneficiaries incorporated safer building techniques. Monitoring at the completion of each tranche was completed by engineers from the organization. The organization conducted a training with carpenters in order to ensure that builders were qualified.

Latrines were also bundled with shelter assistance and offered through a direct build or cash transfer option. 62% of beneficiaries opted for the cash transfer option for latrines. Cash transfers were higher in other regions, however Tacloban's high water table and complex urban environment meant that greater technical assistance was required for many households, accounting for the lower number of beneficiaries using the cash transfer option for WASH infrastructure.

In addition to a direct build option, 3 cash transfer packages were offered based on household needs. These included: major damage, minor damage, and vent pipe only. If only vent pipes were needed, P1,000 was provided. For both major and minor damages, a toilet bowl was also provided. The value of major and minor packages is presented in the table below.

Summary of WASH Assistance Categories.

Major damage	Minor damage
P10,000 + CGI + toilet bowl	P6,800 + CGI + toilet bowl

Transitional Shelter

For those households in the 'no-build zone' they were provided the option to relocate to a transitional site. By moving to this site, the local government ensured that these households would not lose eligibility to be moved to permanent resettlement sites. Construction of these shelters was completed through direct build.

Rental and Hosting Support

Aside from the availability of moving to transitional housing, beneficiaries could also opt for rental subsidies or hosting support. Apartment or housing rental subsidies were for P3,000/month for 2 years (P72,000 total). In place of renting existing units, beneficiaries could use support to rent land (P14,400 for 2 years) and receive P33,000 for shelter construction support. Hosting family support covered the same amount, however at least 50% was supposed to be used by the hosting family for upgrades. Both rental and hosting support also provided to up P10,000 for WASH upgrades and materials.

In total, 18% of beneficiaries claimed apartment or housing rental subsidies, 22% claimed land rental and construction support, and 9% claimed hosting support. In most cases beneficiaries were able to secure shelter through these modalities for less than the allocated amounts and were able to put extra cash toward education and medical expenses as well as livelihoods. Despite these successes, most households that were offered shelter outside the community returned to the 'no-build zone' within a year because of lacking economic opportunities and social ties in their new locations.

Strengths

- ✓ Available of rental subsidies, hosting support, off-site transitional shelter, and multiple packages of on-site assistance allowed for modalities to be targeted to individual household needs.
- ✓ Construction of communal spaces, such as basketball courts provided buffer along social zones while also creating more livable spaces.
- ✓ Cash transfers were found to be especially effective as beneficiaries were able to find materials and labor at reduced costs, allowing for excess cash to support livelihoods, education, and medical expenses.

Challenges and Lessons

- Most households receiving hosting or rental support had returned to original sites in the 'no-build zone' within a year because of lacking economic opportunities in nearby communities.
- Contract for land on transitional site was only secured for 2 years and was misaligned with pace of permanent construction at government relocation sites, with concerns expressed over continued ability to house beneficiaries in interim period.

Right: A beneficiary used a minor damage cash transfer to upgrade and repair their house to a second story to increase living space.

Bottom: In addition to shelter, the organization also targeted community infrastructure, such as basketball courts.

Repair & Retrofit | Transitional | Core/Progressive | Rental | Hosting | Resettlement

Case 14: San Jose, Tacloban, Leyte

Overview

The community of San Jose lies near Tacloban's airport, reaching out into the Gulf of Leyte. The population of 1,572 (barangay 85), saw the worst of Haiyan, the flat geography providing little protection from the immense storm surge. Designated for relocation after Haiyan due to its high vulnerability to future storm surge, the government prohibited the use of 'permanent' materials, limiting the assistance that organizations were able to provide.

Entering to provide temporary shelter assistance to residents, the organization utilized conditional cash grants aimed to repair partial damage to standing structures, and a starting place for those with no home left. The lead organization selected to partner with a Philippine-based NGO as an implementing partner, leveraging their past disaster experience in the Philippines.

Condition Cash Grants

Cash grants varied between P6,000 and P20,000. For vulnerable households, an additional P1,000 was added to the value of assistance to cover additional labor costs. In place of using direct cash transfers, the organization opted for cash vouchers and worked with suppliers to bring materials to the community – a 'mobile store' in essence. Different from material kits, beneficiaries were able to hand pick individual materials up to their grant value. This allowed for greater choice and also suited materials to the individual needs of households. For internally displaced persons (IDPs) still living in tents, the value of the assistance was increased to P20,000.

Map of project location

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234
Households

P6,000-P20,000
Materials
P0-P1,000
Labor

5
Months

Local Oversight

Prior to distribution of kits, clusters of 25-30 households elected a 'build back safer committee representative.' More often than not, these ended up being local purok, or neighborhood, leaders. These selected representatives were then trained on safer construction techniques and this knowledge was then passed to residents. Training sessions involved the use of a scaled model shelter to demonstrate concepts, incorporating active components.

No labor assistance was grouped with the conditional cash transfer, requiring that households hire their own labor. This was difficult for many beneficiaries given sharp increases in labor demand, and subsequently daily labor rates. Similar approaches taken to negotiate material pricing with vendors, could have been applied to labor to control rates.

Uncertainty and Relocation

A challenge both for the organization providing shelter assistance, and households, was the uncertainty of relocation. As planning efforts emerged from the City of Tacloban, all households in San Jose were targeted for resettlement to sites in northern Tacloban. Lacking communication from the local government left many households unsure whether to invest in shelter in their long standing place of residence or wait until government housing assistance would be provided. It took more than a year before households started to be relocated to transitional sites in the north; the process would take much longer for other households. In the face of the unknown, many decided to forego investment in previous houses – the resulting shelter assistance proved an effective solution given this response from households.

Strengths

- ✓ Delegation of construction inspection to household cluster representatives was effective and instilled sense of community responsibility in safer building.
- ✓ Organization was able to incorporate a number of safer building messages despite government restrictions on 'permanent' materials in the 'no-build zone'; the use of timber anchored foundations instead of concrete footings was one example.
- ✓ Cash-based approach provided greater household decision-making.
- ✓ Local-based organization led advocacy for use of light material in 'no-build zone.'

Challenges and Lessons

- WASH assistance was a missed opportunity as most coastal household had toilets without any containment.
- Some beneficiaries sold their vouchers, however it is estimated that less than 10% did so, based on organizational reporting.

Top: Coastal households lacked containment for sanitation facilities.

Bottom: In addition to traditional shelter needs, many beneficiaries were able to use materials for sari-sari storefronts.

Repair & Retrofit | Transitional | Core/Progressive | Rental | Hosting | Resettlement

Case 15: Hiabangan, Dagami, Leyte

Map of project location

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165
Households

15,000-P80,000
Materials
P0-P20,000
Labor

12
Months

Overview

Located south of Tacloban in the Municipality of Dagami, the community of Hiabangan, with a population of 958, is situated in the foothills of the mountains. Its geography is distinctly different from the coastal communities that comprise most settlement in Leyte. Being rural, the majority of habitants are farmers.

The organization began operations early in the response, providing non-food items (NFIs) during the emergency phase to households in Hiabangan. Further assistance evolved from these early efforts into providing more comprehensive shelter assistance. Two shelter options were provided to meet different household needs: (1) shelter repair kits and (1) direct-build core shelters. Over 90% of assistance consisted of repair kits with distribution occurring in the middle of 2014. There was a deliberate emphasis on self-recovery efforts, which was well suited to the self-sufficient mindset of this rural community.

Shelter designs and applications of the distributed materials varied widely across households. In addition to the repair kits, a limited number of full structures were constructed for more vulnerable families in the community. These were built using coconut lumber, plywood, and a gable style roof.

As land conflicts did not arise after Haiyan in Hiabangan, the organization did not intervene in housing, land, and property (HLP) issues. Despite the absence of conflicts, few of the households in Hiabangan own the land they reside on, but do have permission, in most cases, to occupy the space.

Indigenous Coping Strategies

Lying in the highlands, Hiabangan is faced with reoccurring flooding. Despite the significant wind damage from Haiyan, flooding hazards more regularly impact households, with a majority living within a floodplain. An interesting coping strategy for these reoccurring hazards was the practice of *bayanihan*, or moving houses in the spirit of community collaboration. In particular, the absence of foundations often meant that houses would wash downstream intact, only to be picked back up and moved back on-site. While these practices may or may not be sustainable, they certainly pose interesting implications for how organizations think of coping and adaptation strategies for shelter.

Strengths

- ✓ Material kits enabled beneficiaries to combine with personal resources for more cohesive, and larger, shelter.
- ✓ Combined direct build and material kit modalities assisted large percentage of population while ensuring that vulnerable households received extra support, ensuring adequate and equitable shelter for all.

Challenges and Lessons

- Decision not to relocate some households adjacent to riverbeds led to damage to shelters and livestock in flood event within a year; while not necessary to relocate all households in high risk areas, future efforts should focus on preparatory strategies to strengthen shelters and livelihoods before these hazard events.
- Raised floors provided protection from flood water in high risk households, but flooring deteriorated rapidly and had high deflection because of thin plywood.

Top (2 photos): A limited number of core shelters shown were constructed for the most vulnerable families.

Bottom (2 photos): Shelter materials kits were used in a variety of ways including repairing damaged houses and adding sari-sari storefront to existing houses.

Repair & Retrofit	Transitional	Core/Progressive	Rental	Hosting	Resettlement

Case 16: Sagkahan, Tacloban, Leyte

Overview

As an urban community within Tacloban City, Sagkahan borders Real Street, a busy thoroughfare that connects the city center to the airport and Tacloban's bustling mall. The population of 1,434 (barangay 62) and nearby communities have swelled in growth over the last decade as Tacloban continues to develop. Sagkahan suffered some of the greatest loss of life during Haiyan, a result of the nearly 6m (20ft) storm surge. Seeking to provide integrated recovery solutions, the organization providing assistance linked shelter with WASH, protection, and disaster risk reduction (DRR) support.

Map of project location

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484
Households

P15,000-P180,000
Materials
P6,000-P50,000
Labor

19
Months

Tailored Solutions

Shelter support provided to beneficiaries included support for land rentals, hosting, repair and retrofits, and new construction. For repairs and retrofits, the organization shouldered the cost of materials and labor. Inspections were completed both prior to, and during construction, to ensure that upgrades to damaged structures would improve the strength and livability of the shelter. A range of innovative designs were developed for new construction, including duplexes and two story shelters, to address challenges of working in an urban context. In most cases, land agreements were secured for between 5 and 10 years for new construction. The program uniquely selected to provide hard wood in place of coconut lumber for greater durability and strength of structures. A number of other hazard-resistant features, including strapping, concrete foundations, and bracing were added to new and existing shelters.

Rental support was aimed at restoring the available stock of rental properties available.

Top: Duplexes, two story shelters, and a variety of alternatives assisted meet the complex urban environment of Sagkahan.

Bottom: A pair of broken and unused rainwater collection tanks highlight one of the few flaws of assistance provided.

This assistance consisted of reconstructing shelters for landlords and securing 5-year rental agreements for households that were previously renters. Hosting support was yet another means of tackling shelter needs by placing families in existing housing units that were partially damaged. In many cases hosting arrangements have evolved into more permanent arrangements between family members sharing a house.

The organization also worked closely with hired skilled labor to develop contracting teams for the large amount of infrastructure construction needed. These teams were trained on financial management and estimating techniques, eventually allowing the organization to bid out clusters of shelters to labor teams.

Protection

One of central themes of the shelter approach that was different from other programs was a focus on protection issues. Women and children were both consulted separately to facilitate feedback in the development of shelter designs. Open spaces were constructed for children and solar street lighting added to reduce previously high rates of domestic violence and assaults at night.

Disaster Risk Reduction

Support also targeted DRR measures within Sagkahan, including preparedness equipment, early warning alerts, and evacuation drills. A community wide evacuation drill was carried out which aimed to better inform households of where they should head during oncoming typhoons or other disasters.

WASH

Latrines were included in all new construction. During observations one year after construction, most toilets appeared to have backed up due the site's high water table. In other projects conducted in adjacent communities raised septic tanks appeared to be one method of improving the performance and functionality of systems.

Rainwater collection systems were also provided to each household; however, these saw limited use. Pipe breaks and nearby sustainable sources of water were the two primary reasons these were not used.

Strengths

- ✓ Protection was addressed in multiple dimensions of shelter and settlement, including interior partitions, solar street lighting, child-friendly play spaces, and seminars.
- ✓ Similar to other urban approaches, two story structures were able to meet household needs with limited available land.
- ✓ Inclusion of women and children into decision-making led to creation of child-friendly spaces, including playgrounds and open spaces; organization encourage involvement of women in construction sector.
- ✓ Creation of homeowners' associations allowed beneficiaries to pool capital in order to seek a bank loan for purchasing land.
- ✓ Availability of land rental support, hosting support, off-site transitional shelter, and 3 packages ranging from roofing repair kits to cores shelters, allowed for modalities to be targeted to individual household needs.

Challenges and Lessons

- High water table in community led to the failure of over 50% of septic tanks; raised tanks may have been an alternative solution to improve performance.
- Rainwater collection systems were not used by households because of other sustainable sources of water; failure to fix pipe breaks were another reason these were not used.

Top: Each cluster of households was able to select a color to paint their shelter.

Bottom: A key feature of the program was the development of child-friendly spaces, such as the one shown.

Eastern Samar Overview

As one of the easternmost provinces in the Philippines, Eastern Samar rests at the edge of the vast Pacific Ocean. Fishing and coconut farming were the two predominant industries prior to Haiyan, both heavily affected by the storm's damage. The low lying communities were inundated with storm surge in excess of 3m (10ft). Peak wind speeds were in excess of 315kph (195mph) lashed existing infrastructure. While the response here exhibited similar themes to other provinces, rural settlement patterns create different needs for affected populations, and thus necessitated different implementation strategies.

The province became a focus point for shelter assistance given its notoriety as Haiyan's first landfall, bearing the brunt of the storm. During early stages of the response, Guiuan was a 5 (or more) hour drive from the nearest airport in Tacloban, and its isolation affected shelter logistics and strategy. Guiuan does possess its own airport runway that was used selectively during the immediate days after Haiyan, however no commercial airlines fly into the airport. It also has a small port, however, it sees limited sea traffic from other islands and road infrastructure is Guiuan's primary connection to goods. The main thoroughfare highway was undergoing major construction and improvements at the time of Haiyan, and was a constraint on programs transporting materials and supplies from the regional hubs of Tacloban and Borongan.

Need and Response

27,699 houses were partially damaged and 33,972 houses were totally damaged in the province of Eastern Samar following Haiyan (Shelter Cluster 2014b). 47,740 households were targeted for shelter assistance by 16 organizations. The 3 cases presented in this section were selected in the Municipality of Guiuan, in part due to the large presence of need and assistance provided here. Of the 61,671 households affected in Eastern Samar, 11,609, or 19%, were located in Guiuan.

Map of Eastern Samar
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Coordination

While the Shelter Cluster maintained a hub in Guiuan for the first year of the response and a Humanitarian Shelter Working Group (HWSG) was maintained informally afterwards, the geographic isolation and low population density of Eastern Samar meant informal ties and government leadership overshadowed much of Cluster coordination efforts. The Municipal Disaster Risk Reduction and Management Office (MDRRMO) of Guiuan took the lead role in coordinating recovery efforts and established a robust plan to tackle reconstruction activities. The rural context of Guiuan, and the presence of fewer shelter organizations, eased coordination challenges that were seen in other provinces. In order to avoid duplication, organizations relied on geographically distancing themselves from other shelter programs. While this wasn't always possible in urban contexts, such as

Tacloban, the ability to disperse placed less stress on coordination demands.

Rural Settlement

Guiuan is an upcoming center of development, but the majority of the municipality consists of rural households. Self-recovery assistance was the most predominant modality used to meet the needs of households, partly due to less complexity with land rights and relocation. Some coastal households were required to relocate, but the majority within the region were able to return to their existing sites, allowing for in-situ building. One example of the relocation used in Guiuan is highlighted in Case 18. Both of the other cases leveraged household's resourcefulness in procuring materials and hiring of labor.

Logistically, the rural context necessitated that organizations approach shelter as one component of a larger recovery agenda. Existing infrastructure, and shelter, was often less robust before Haiyan and there was a large knowledge skills gap among many households.

Left: Remnants of a house are a reminder of the storm surge that swept through Guiuan.

Right: Coconut lumber was abundantly available in Eastern Samar where coconut farming was one of the most common livelihoods before Haiyan.

Bottom: Unlike other urban contexts, Guiuan and other rural areas often provided exceptions to the 'no-build zone.'

Repair & Retrofit	Transitional	Core/Progressive	Rental	Hosting	Resettlement

Case 17: Sulangan, Guiuan, Eastern Samar

Overview

The community of Sulangan lies at the tip of Eastern Samar. The majority of the population of 3,597 live in the densely populated town center; however, a significant number of families live in dispersed settlements along the coast. Prior to Haiyan, most residents were fishermen and coconut farmers; livelihoods that were heavily impacted by damage to fishing boats and coconut trees. Connected through the Catholic church, two partner organizations entered to provide shelter assistance. The integrated program focused on shelter, WASH, livelihood, and education support. Flexible donor funding and a planned timeline of 3 years allowed for greater depth of resilience building activities and inclusion of disaster risk reduction principles across sectors.

During early months, the lead organization led community mapping exercises to identify damaged houses. This activity was intended to provide risk awareness of where damage occurred within the community and also provide a participative beneficiary selection process. Lists of damaged households were publically posted prior to finalizing. Several pilot houses were constructed following these

Map of project location

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63
Households

P55,000-P144,00
Materials
P20,000-P44,000
Labor

36
Months

exercises in order to solicit feedback from carpenters on ways to improve designs and reduce cost. Focus groups with men and women were conducted separately to identify desirable housing traits to include in designs, based on the pilot houses. Several sets of timber and masonry designs were finalized from this feedback. Additional repair & retrofit packages were also later developed for households with partial damage. The program notably used the National Building Code of the Philippines as the standard to which all housing was designed.

A Homeowner-Driven Approach

The shelter program utilized a homeowner-driven approach in order to manage construction activities. In consultation with an architect from the organization, each beneficiary was allowed to select the arrangement of select housing components, such as windows and doors. Beneficiaries were also allowed to select either a concrete or timber veranda. Beneficiaries could opt to contribute personal funds and select a larger floorplan if desired. While these additional material and labor costs were the responsibility of the beneficiary household, the design costs were covered by the organization.

Poster of available design options available.

Those households located in the less developed areas of the community were targeted for timber designs and those in the more densely populated areas were targeted for confined masonry and reinforced concrete moment frame structures. Designs allowed for vertical and lateral expansions by homeowners at a later time. For example, column reinforcement was extended vertically to allow for continuation into second story columns in the future.

Each beneficiary was responsible for selecting their own local builder. This leveraged local ties and was intended to build trust between the beneficiary and builder. The organization also maintained a list of trained builders in order to pre-qualify carpenters and masons for construction in the event that the beneficiary was unable to find a builder. Following selection, both the beneficiary and the builder were trained by the organization on safer building techniques. The beneficiary training focused on identifying quality building materials and a basic overview of key features required for construction. One example, was the need to ensure that reinforcement was included on all sides of openings, such as windows. The builder training, in contrast, covered more technical aspects of building and involved both a lecture and demonstration component. Batches of 10 households were trained at a time.

Demonstration training for block laying.

For construction, the organization provided cash transfers in 4 tranches. These corresponded to work packages for: (1) foundations and site work, (2) columns and walls, and (3) roofing and finishes. The fourth tranche was a 'builder's hold back,' intended to ensure that the builder completed the entire scope of work. At completion of each tranche the beneficiary would request an inspection by an engineer representative from the organization. Periodic inspections at other times also occurred, but were not scheduled. If any aspects of the construction were found to be deficient by the inspection, the beneficiary was responsible fixing issues. Any costs associated with rework were the responsibility of the beneficiary and builder. Beneficiaries were encouraged not to pay builders upfront in order to ensure that construction met

Alternative timber design house with masonry skirt.

requirements, however payment for materials upfront was commonly needed as local builders often lacked the capital to front these costs. Upon satisfactory completion of a tranche, cash and the work package for the next phase of construction was released.

WASH and Livelihoods

The shelter program notably integrated WASH and livelihoods. For households lacking toilets, a separate package of two tranches was provided to build a septic tank and walls. Late in the project, these cash transfers were included with shelter tranches. Toilets were advised to be detached from the house for structural reasons, however final determination was the beneficiary's decision. Further, livelihood assistance strengthened and diversified income opportunities, including the following groups: Small Business Women's Association (SBWA), Garments Designers' Association (GDA), Creative and Resilient Entrepreneurs for Development (CREeD), and Comverse Fisherfolks' Association (CFA).

Construction Training Center

In addition to providing training to builders involved in housing being constructed, the organization also partnered with Eastern Visayas State University (EVSU) and the Philippine Technical Education and Skills Development Authority (TESDA) to develop a training facility for carpenters and masons. The organization assisted in reviewing existing TESDA curriculum and constructed demonstration facilities that showed 6 phases of construction on a housing unit. These efforts have helped to sustainably promote improved skills development in the region.

Strengths

- ✓ High level of oversight during construction led to high quality of housing units.
- ✓ In the absence of evacuation centers in the area, constructed masonry houses now serve as safe location for evacuation.
- ✓ Designs accounted for expansions, promoting safer additions.
- ✓ Variety of tailored designs were able to better suit needs of households, including two story houses for those with limited land and masonry for fire safety in densely settled areas.

Challenges

- Estimated cost of materials were often misaligned with market prices, leading to inadequate funds for beneficiary to purchase needed materials for tranches.
- Heavy investment in early feedback and higher than expected shelter costs reduced the final number of beneficiary households and reduced available scope of houses.
- Later designs were notably less robust due to reduced budget, leading to higher dis-satisfaction of beneficiaries receiving assistance during later phases.

Shelter design developed in later phase under reduced budget.

Repair & Retrofit | Transitional | Core/Progressive | Rental | Hosting | Resettlement

Case 18: Cogon, Guiuan, Eastern Samar

Overview

Following Haiyan, a number of households in the Municipality of Guiuan were not permitted to return to their previous living sites after the local government unit (LGU) began enforcing a 40 meter no-build zone. The largest number of individuals impacted previously lived along a jetty extending from shore; this area was deemed unsafe for return and redevelopment. These households spent the first year living in a tent city that arose while the municipality and international organizations developed plans to develop a transitional site and long-term resettlement options were considered. Cogon, a community with population of 1,146, was eventually selected.

From initial planning efforts, the transitional site was intended to be a multi-agency effort. One organization took the lead on shelter activities, while two other organizations aimed to provide water and sanitation infrastructure. Other partners brought in included the Department of Science and Technology (DST) for hazard and vulnerability analysis, the Rural Development Association (RDA) for disaster risk reduction activities, and the Department for Social Welfare and Development (DSWD)

Map of project location

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133
Households

P61,000
Materials
P16,000
Labor

12
Months

for coordination and identification of beneficiaries. An additional two organizations partnered to focus on enterprise development and livelihoods.

A suitable site was identified and construction began approximately 10 months after Haiyan. The transitional shelters were completed within 2 months and WASH infrastructure was installed in the months following. The shelter designs made use of coconut lumber with amakan walling along with corrugated galvanized iron (CGI) roofing and included a small front porch with a hanging kitchen attached to the back of the units. The shelters also included steel strapping across roofing edges that was anchored to concrete foundations in order to tie down components. These were directly bolted into roof members. The organization directly hired labor for construction and oversaw field completion.

WASH Management Hurdles

Following completion of all transitional shelters, two partner organizations provided water and sanitation infrastructure to support the new site. One organization targeted water infrastructure through the installation of a central well with electic pump and several storage tanks. Despite the investment of this infrastructure, the cost of use and maintenance was prohibitive for most households who refused to pay the needed operational costs of P100/month. As a result, the system has not been used and nearby wells have become the primary source of water.

There were also challenges with the implementation of sanitation infrastructure – the second partner organization opted to use plastic barrel drums for septic tanks. The small size of these tanks and clay soil conditions led to these systems backing up shortly after commisioning. Most households removed these systems and replaced them with unlined pits for better percolation.

The site water storage and pump system that has gone unused.

Transition to Permanent Housing

Despite initial hurdles to transfer land ownership to beneficiaries, the LGU was making progress to establish a payment plan. Land ownership payments had yet to start at the time of observation, but it was expected that each household would pay P50/month over a period of 18 years for a total of P10,800 to titling. Further, the LGU was seeking additional funding from the national level in order to start construction of permanent homes to replace the transitional shelters. Each permanent house is expected to be built on the same site as the transitional shelter. These permanent houses will be constructed in batches, transferring families to a central bunk house that was constructed in the center of the transitional site. As houses are completed, households will move into their newly completed units while the next batch is transitioned to the bunk house.

Transitional bunk house to be used while permanent houses are constructed.

Community Infrastructure

The transitional site also developed other infrastructure, including a social enterprise hall for women and basketball courts for children. Unlined drainage ditches were also installed on the site with the intention that these could be upgraded to more permanent, lined drainage as future site development continued.

Strengths

- ✓ Project relocated households in the no-build zone to safe location.
- ✓ Project included robust designs, included steel straps tied from foundation over roofing and double member trusses.
- ✓ Shelters included special features for persons with disabilities (PWDs), such as access ramps instead of stairs.

Challenges

- Beneficiaries noted that water passed through the amakan walls when it rained, resulting in most placing plastic tarps over walls, reducing ventilation.
- Installed septic tanks failed within the first 2 months of use due to poor soil conditions and inadequate sizing.
- Untreated coconut lumber showed significant deterioration from termites within the first 2 years on most shelters.
- Water infrastructure went unused as a result of conflicts in payment collection and concerns over mosquitos following a dengue outbreak.

Left: Basketball court and social enterprise center.

Right: Interior of shelter.

Bottom: Shelter with beneficiary adaptations.

Repair & Retrofit	Transitional	**Core/Progressive**	Rental	Hosting	Resettlement

Case 19: Cantahay, Guiuan, Eastern Samar

Overview

Situated inland within the Municipality of Guiuan, Cantahay's population of 1,118 is a sparsely populated community that relies on farming for its primary source of income. To address immediate and pressing shelter needs, organizational assistance focused on providing core shelters.

The shelters were designed to last an expected 10 years, easing transition to self-recovery and household driven initiatives. Shelters were constructed of amakan walling and coconut lumber, similar to other shelter designs seen across the response. The use of concrete footings, metal strapping, and a hipped roof design are features that contributed to safer structures. Latrines were not included initially, but later added during a second project phase.

Map of project location

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105
Households

P56,000
Materials
P14,000
Labor

12
Months

Material Procurement

Beneficiaries were asked to contribute the coconut lumber for their shelter in order to expedite the construction. The organization shouldered the costs associated with cutting the lumber. Within Cantahay this approach was found to be an effective strategy to make use of the large number of downed coconut trees on-site and reduced transportation costs. In other mountain communities where the organization was working, procurement through this method provided challenging in some cases because of few available coconut trees.

Aside from coconut lumber, roofing materials and steel reinforcement for the footings were procured either nationally or internationally. These materials were unavailable at the volumes required for the program, however attempts were made at local procurement prior to opting for import.

Orientation and Training

Prior to the start of construction several orientation sessions were held for beneficiaries. These outlined the construction process and responsibilities and basic principles of safer building. A large of households reported not attending these sessions, partly due to the timing of meetings. Future programs should seek to select appropriate times and hold these orientations in clusters closer to households.

Given a severe construction labor shortage, the organization facilitated a 10-day training for individuals interested in construction employment. The organization provided a short lecture followed by on-site supervision for the remainder of the training period. The practical component was overseen by a more experienced carpenter who led a team of 4-5 individuals. This strategy was effective in attracting individuals to fill the labor gap; however, retention rates were low because of competing wages from other shelter organizations working in the area.

Strapping was one of several design features emphasized in training sessions.

Upon turnover, the organization provided a pictorial operations manual for maintenance and guidance on expansions. While these were well intended, few beneficiaries actually read the manuals and verbal instructions could have potentially better conveyed this information.

Phased WASH

During ongoing construction, it was determined that there was also a significant need for WASH assistance in the community. Following completion of shelters, a partner organization returned to provide latrines for those initial households who received assistance but lacked access to sanitation facilities. In most cases, even existing septic tanks and toilets were deemed inadequate (either full or partially functional) and replaced. Hygiene promotion sessions also accompanied the delivery of provided 'hard' infrastructure.

Strengths

- ✓ Shelters were rapidly constructed, a result of a replicable design used across multiple communities.
- ✓ Shelters had large interior living space and were well ventilated.
- ✓ Procurement of coconut lumber by beneficiaries expedited construction and reduced transportation costs.

Challenges and Lessons

- Two shelters collapsed during Typhoon Hagupit in 2014 due to inadequate lateral bracing.
- Skilled labor was difficult to acquire and turnover rates of carpenters were high, impacted by wage differences between shelter organizations in the region. This could have been addressed through improved coordination and standardized wage rates.

Shelter materials show signs of wear

APPENDIX C DATA COLLECTION INSTRUMENTS

This section includes all data collection instruments used to gather data. The first section includes the interview scripts for households and organizations during first and second field visits during the planning, design, and construction phases of selected shelter projects. The subsequent section presents the survey used to assess project outcomes in communities. During collection, the Qualtrics data platform was used to ask the questions verbally and responses were recorded on a tablet. Three separate surveys were used for households, barangay officials, and municipal officials.

HOUSEHOLD QUESTIONS

INTRODUCTION

- What is your current occupation? Your spouse (if applicable)? Is this the same as prior to Yolanda?
- Did you relocate after Yolanda? Can you describe this process? Did the government require relocation?

COORDINATION

- What are your current priorities (income, shelter, etc.)?
    - What were your priorities after Yolanda? How have your priorities changed, if at all, since Ruby?
    - What were your rebuilding priorities (infrastructure) after Yolanda?
- How did you know what would happen with temporary, transitional, or permanent housing and infrastructure after Yolanda?
- How were you informed which organizations would be working in your barangay?
    - When did this occur?
- What organizations are currently working in your barangay?
    - How did you know that the organization would be working in your barangay?
    - How do these organizations communicate with you?
        - What portion of these interactions are face-face meetings? Text? Social media? Other? What projects are these organizations currently working on?
    - What, if any, methods of communication do you use to connect and communicate with organizations working in your barangay?
- How does the government communicate to you?
- Are there any tensions with any of these relationships? What do they stem from?
- In recent months how has coordination changed? Can you describe how?
- Did you notice any changes in coordination, housing, or infrastructure after Ruby?
    - How did Ruby impact your house?
    - How did Ruby impact your barangay?
    - What did you do differently to prepare for Ruby as compared to Yolanda?
        - Where did you hear about Ruby?
        - Did you evacuate? Where?

HOUSEHOLD QUESTIONS (CONT.)

STAKEHOLDER PARTICIPATION

Decision-Making

- Who designed or make decisions regarding your house floorplan and features?
    - What features were important to you? Were these incorporated into the final plan?
    - What aspects about your house to do you like? What do you not like or would you change if you could?
- How was the choice of building materials decided?
    - What materials do you believe are the best? Why?
    - What is the worst? Why?
- Who designed the current housing model?
    - Describe the process to reach a final design. Who was involved? How were designs presented to you?
    - What typhoon-resistant aspects were incorporated?
- How were you selected as a beneficiary?
    - What were the criteria? How was this communicated to you?

If Relocation:

- How was the relocation site selected?
- Were you given a choice of where to relocate?

Implementation

- What is the cost of your house?
    - How is the money for labor/materials distributed?
    - Do you provide cash for the house?
- Who purchases/provides the building materials?
    - Where are they purchased?
    - In what amounts/quantities?
- Who is providing labor for the project?
    - How long does it take to complete a house on average?

Evaluation

- Are you involved in helping with construction? Or overseeing/monitoring construction? After construction? How?
    - What aspects do you oversee?
    - What, if any, information was given to you to assist in this oversight?
- Is there a process for you to provide feedback/report complaints?
    - How you think these are handled?

HOUSEHOLD QUESTIONS (CONT.)

TRAINING

- Have you recently attended a training session provided by an organization?
- Can you walk me through how you were informed about this session, why you were invited to attend, and what was provided in the training?

Attended Training

- How were you informed about the training?
- What organization provided the training?
- Why were you interested in attending the training?
  - What did you hope to gain?
  - What skills or knowledge did you hope to gain?
  - What did you actually learn?
- Can you describe the training?
  - In what language was it?
  - Who led the session(s)?
  - Where was it held?
  - How long was the training?
- Were materials provided to you?
  - Were these helpful? In what ways?
  - Do you have these materials?
- What aspects of the training program was easy to understand?
  - Hard to understand?
- What, if any, incentives were used to gain interest/participation in the training?
  - Were you required to pay for the training? Were you paid?
  - How will the training benefit you?
- How did you hear about the training program?
- Why were you interested in attending the training?
- What suggestions do you have that might have made the training better?

Did Not Attend Training

- Have you heard of any training programs being provided in the area/your barangay?
  - How did you hear about these?
- What types of training would be useful?
  - Would you pay for this training?
  - How far would you travel for a training?

Is there anything else you would like us to know?

Organization Questions

Introduction

- When did your organization begin working in the Philippines?
  - How long does your organization plan to stay?
- How many employees does your organization employ (approximately) in the Philippines? Volunteers? Percent expat vs. local staff?
  - Has this changed since early recovery efforts? How and why?
  - How many are employed for this project?
- What is the current status of this project? Expected completion?

Coordination

- What are the goals of this project? Are there any metrics for measuring success?
  - Has this changed as reconstruction efforts have progressed?
- Who are your donors of this project?
- What, if any, are your donor reporting requirements?
  - How frequently are these reports submitted?
- What, if any, performance requirements (e.g. building codes, people served, budget, etc.) are you trying to meet for this project?
- **How does your organization coordinate across sectors? Within sectors?**
  - Do you coordinate with the organizations working in the same barangay that are working on WASH activities?
- Do you participate in ongoing government cluster meetings? Which ones? If not, why?
  - How often do you attend these meetings?
  - How has coordination under the new government clusters differed from past efforts under the UN system?
- Do you attend the *Humanitarian Shelter Working Group* meetings? If not, why?
  - How often do you attend these meetings?
  - Who is the lead organization?
- Do you coordinate through any informal means (e.g. common social places, etc.)?
- Overall, what has worked well to coordinate? What has not?
- What coordination barriers have arisen?
- What, if any, project elements are not being coordinated? Why?
- In recent months how has coordination changed?
- Did you notice any changes in coordination efforts after Ruby?
  - How did Ruby impact your current project?

Network Questions

Please list the organizations, communities, and/or government agencies you communicated with during the first six months after Yolanda. *(Repeat for present)*

- Were you coordinating with this entity before Yolanda?
  - Where? On what projects?
- At what level is this coordination (project, barangay, province, region, or national)?
- What type of information or resources are you sharing?
- How frequently are you communicating?
- Is it a formal relationship or informal?
- Are there any tensions? What do they stem from?

STAKEHOLDER PARTICIPATION

Decision-Making

- Who decided the house floorplan and features?
    - How was this decided and communicated to the housing beneficiary? Other community members?
    - What features were important to the housing beneficiary? The municipality/barangay? Your organization?
- How was the choice of building materials decided?
    - What factors were important in this decision?
- Who designed the current housing model?
    - Describe the process to reach a final design. Who was involved? How were designs presented to beneficiaries?
    - What hazard-resistant aspects were incorporated?
- What process was used to select housing beneficiaries?
    - When were they selected?
- How was the type of housing assistance (repair, temporary, permanent, etc.) decided?
    - Who provided the land for the project?

If Relocation:

- How was the relocation site selected?
- What factors were considered in selecting a site?

Implementation

- What is the cost of a single house?
    - How is the money for labor/materials distributed?
    - Is the beneficiary providing cash? The municipality? Other government agency?
- Who purchases/provides the building materials?
    - Where are they purchased?
    - In what amounts/quantities?
- Who is providing labor for the project?
    - Is there a requirement for a beneficiary to contribute labor or cash?
    - How long does it take to complete a house on average?

Evaluation

- Is your organization involved in monitoring/oversight during construction? After construction?
    - What aspects do you oversee?
- What role did the beneficiaries have in monitoring/evaluation?
    - Were they provided any resources to assist with this (feedback boxes, hotline, etc.)?
    - What information is provided to the beneficiary about maintenance? When was this information provided?

TRAINING

Goals and Objectives

- What aspects of the current project require training individuals (carpenters, your own staff, government, etc.)?
    - What skills or knowledge do you aim to transfer to these individuals?
- How many individuals are you trying to train?
- Do you have written learning objectives or expected outcomes?

Knowledge Transfer

- How is training administered?
    - In what language?
    - Where are they held?
    - How long are these training sessions?
- When is on-site vs. off-site training used?
- What materials do you use to train individuals?
    - How were these materials developed?
- What aspects of training programs are easily understood by trainees?
    - Hard to understand?
- *How do you assess effectiveness of training?*
- *What are lessons learned—things not to do again as well as training methods that work well?*

Motivations

- What, if any, incentives are used to gain interest/participation in training programs?
- Are trainees required to pay? Are they paid?
- How do you solicit and distribute information about availability of training programs?
- Do you offer any formal certifications?

Now that you know about our study, what questions should we have asked that we didn't?
What aspects of post-disaster reconstruction and recovery do you think still need to be investigated?

Household Survey

When constructed structure:

Year and Month

Number of rooms:

Land Ownership:

- ❍ Own (with land title)
- ❍ Own (w/o land title)
- ❍ Rent (paid)
- ❍ Rent (free)
- ❍ Informal settlement

Does your house have building permit from the municipality?

- ❍ Yes
- ❍ No
- ❍ Not Sure

What/where is the nearest body of water? ASSESS HOW HIGH. Elevation above nearest body of water:

- ❍ 0-1 meters
- ❍ 1-2 meters
- ❍ 2-3 meters
- ❍ 3-4 meters
- ❍ 4-5 meters
- ❍ 5+ meters

Foundations, Walls, Roofing, Connection

Type:

Walls	Roofing	Connections
❑ Amakan ❑ Coconut ❑ Hardwood ❑ Plywood ❑ Masonry	❑ Tarpaulin ❑ Nipa ❑ CGI ❑ Steel ❑ Concrete	❑ Nailed ❑ Wire or Rope ❑ Timber Cleats ❑ Steel Straps ❑ Bolts

Homeowner Assessment:

- ❍ Poor
- ❍ Below Average
- ❍ Above Average
- ❍ Excellent

Deterioration:

How would you compare your current house to your home pre-Yolanda?

- ❍ Much worse
- ❍ Somewhat worse
- ❍ About the same
- ❍ Somewhat better
- ❍ Much better

What is the strongest signal storm you believe your house would survive?

- ❍ Signal 1
- ❍ Signal 2
- ❍ Signal 3
- ❍ Signal 4
- ❍ Signal 5

Explain:

What (if any) additions have you made to your home since handover?

Explain:

What (if any) maintenance have you performed on your home since handover?

If you needed to repair your house, who would you go to?

- ❍ Self-Perform
- ❍ Family Member
- ❍ Skilled Labor (in barangay)
- ❍ Skilled Labor (in another barangay)

What (if any) maintenance will you perform in the future?

Did you receive any maintenance training for your house?

- ❍ Yes
- ❍ No

Explain:

What is your access to sanitation?

- ❍ Private toilet (attached)
- ❍ Private toilet (detached)
- ❍ Shared toilet with neighbor
- ❍ Communal toilet
- ❍ Open Defecation

Type of system:

- ❍ Septic Tank
- ❍ Lined Pit Latrine
- ❍ Unlined Pit Latrine
- ❍ None (ocean or water source)

How will you maintain the system?

Do your sanitation practices change at night?

What is your primary source of drinking water?

- ❍ Tap in home
- ❍ Private tap
- ❍ Communal tap
- ❍ Private well
- ❍ Communal well
- ❍ Home delivery
- ❍ Trucked water
- ❍ Bottled water (store)

Distance to source:

- ❍ 0-1 minutes
- ❍ 1-3 minutes
- ❍ 3-5 minutes
- ❍ 5-10 minutes
- ❍ Over 10 minutes

How often do you have service interruptions?

- ❍ Never
- ❍ Once every few months
- ❍ Once per month
- ❍ Once per week
- ❍ Once per day

What is your primary source of washing/bathing water?

- ❍ Tap in home
- ❍ Communal tap
- ❍ Private well
- ❍ Communal well
- ❍ Stream or pond

Distance to source:

- ❍ 0-1 minutes
- ❍ 1-3 minutes
- ❍ 3-5 minutes
- ❍ 5-10 minutes
- ❍ Over 10 minutes

How often do you have service interruptions?

- ❍ Never
- ❍ Once every few months
- ❍ Once per month
- ❍ Once per week
- ❍ Once per day

Do you have access to electricity?

- ❍ Yes (private)
- ❍ Yes (tapped or shared)
- ❍ No

How often do you have service interruptions?

- ❍ Never
- ❍ Once every few months
- ❍ Once per month
- ❍ Once per week
- ❍ Once per day

Do you have a solar charger or solar lamp?

- ❍ Solar charger
- ❍ Solar lamp

Where is closest paved road? Is your home within 100m of a paved road?

- ❍ Yes
- ❍ No

What is your primary means of transportation?

- ❍ Motorbike
- ❍ Jeepney
- ❍ Tricycle (motor)
- ❍ Tricycle (pedal)
- ❍ Walking

Does your household own a motorbike or tricycle?

- ❍ Yes
- ❍ No

How were you warned for Typhoon Ruby?

- ❑ Neighbor
- ❑ Barangay Official
- ❑ Radio
- ❑ TV

Did you evacuate?

- ❍ Yes
- ❍ No

Where did you evacuate to?

- ❍ Private House (within barangay)
- ❍ Private House (outside barangay)
- ❍ Church
- ❍ Barangay Hall
- ❍ Barangay Health Center
- ❍ School
- ❍ Commercial Building
- ❍ N/A

Have you received any disaster training in the last year?

- ❍ Yes
- ❍ No

Explain:

Size of household:

Number of children under age 18:

Number of school-aged children who attend school:

How frequently do your elementary school aged children attend school?

- ❍ Always
- ❍ Most of the time
- ❍ Sometimes
- ❍ Infrequently
- ❍ N/A

How frequently do your high school aged children attend school?

- ❍ Always
- ❍ Most of the time
- ❍ Sometimes
- ❍ Infrequently
- ❍ N/A

Number of household members with high school diploma:

Number of household members with college degrees:

Number of adults over age 65:

Number of household members with special needs:

Number household members employed:

Weekly household income (PHP):

Weekly expenses (PHP):

Total current savings (PHP):

Do you have access to credit (including micro-finance)?

- ❍ Yes
- ❍ No

How many mobile phones does your household have?

Where were you born?

- ❍ This barangay
- ❍ This municipality
- ❍ This province
- ❍ Other province

Where was your spouse or partner born? (if applicable)

- ❍ This barangay
- ❍ This municipality
- ❍ This province
- ❍ Other province
- ❍ N/A

Is your household involved in any social groups/committees in your barangay, such as a church, women's group or other entity?

Please rate your household's level of involvement:

- ❍ Not active
- ❍ Somewhat active
- ❍ Active
- ❍ Very Active

Do you know your neighbors? Have you helped your neighbors in the last year? How?

Barangay Survey

What is your position?

- ❑ Barangay Captain
- ❑ Barangay Councilor
- ❑ Barangay Health Worker
- ❑ Member of DMRRC

Your barangay has a disaster risk reduction and management council (DRRMC).

- ❍ Yes
- ❍ No

Your barangay has a written disaster management plan.

- ❍ Yes
- ❍ No

What risks did you consider in your disaster management plan?

Does your barangay have any of the following?

- ❑ Salt Marshes
- ❑ Wetlands
- ❑ Mangroves
- ❑ Seawalls
- ❑ Drainage Channels

What percent of your barangay's budget is allocated for disaster management?

Can you say that "The disaster management culture with our municipality and neighbor barangays is collaborative."

- ❍ Strongly disagree
- ❍ Disagree
- ❍ Agree
- ❍ Strongly Agree

We have shared our disaster management plan with neighbor barangays.

- ❍ Yes
- ❍ No

We have shared our disaster management plan with our municipality.

- ❍ Yes
- ❍ No

Please rate the quality of water supply in your barangay.

- ❍ Poor
- ❍ Below average
- ❍ Above average
- ❍ Excellent

Does your barangay have a generator?

- ❍ Yes
- ❍ No
- ❍ Not Sure

Please rate the quality of roads in your barangay.

- ❍ Poor
- ❍ Below average
- ❍ Above average
- ❍ Excellent

Nearest hospitals and distances:

Primary elementary schools and distances:

Primary high schools and distances:

Designated evacuation centers and distances:

Has your barangay offered any disaster training in the last year? Who?

- ❍ Yes
- ❍ No

Relocation (if applicable):

What did you consider in relocating? WHY?

What NEW risks arose after relocating?

Municipality Survey

What is your position?

- ❑ Mayor
- ❑ Municipal Councilor
- ❑ Member of DMRRC
- ❑ Other

Your municipality has a disaster risk reduction and management council (DRRMC).

- ❍ Yes
- ❍ No

Your municipality has a zoning plan.

- ❍ Yes
- ❍ No

Your municipality has a written disaster management plan.

- ❍ Yes
- ❍ No

What risks did you consider in your disaster management plan?

What percent of your municipality's budget is allocated for disaster management?

Can you say that "The disaster management culture with our barangays and neighbor municipalities is collaborative."

- ❍ Strongly disagree
- ❍ Disagree
- ❍ Agree
- ❍ Strongly Agree

We have shared our disaster management plan with neighbor municipalities.

- ❍ Yes
- ❍ No

We have shared our disaster management plan with our barangays.

- ❍ Yes
- ❍ No

Please rate the quality of water supply in your municipality.

- ❍ Poor
- ❍ Below average
- ❍ Above average
- ❍ Excellent

Please rate the quality of roads in your municipality.

- ❍ Poor
- ❍ Below average
- ❍ Above average
- ❍ Excellent

Has your barangay offered any disaster training in the last year?

- ❍ Yes
- ❍ No

Relocation:

What did you consider in relocating barangays?

What risks arose after relocating barangays?

Construction Knowledge Survey

Demographic Information

Please complete the following information about yourself:

Gender (Select one):

☐ Male ☐ Female

Age: ____________________

English Proficiency (Select one):

☐ Beginner
☐ Intermediate
☐ Advanced
☐ Fluent

Highest Educational Attainment (Select one):

☐ College Graduate
☐ College Level (Year Level:_____)
☐ High School Graduate
☐ High School Level (Year Level:_____)
☐ Elementary Graduate
☐ Elementary Level (Grade:_____)
☐ No Formal Education

Were you born in this barangay?

☐ Yes ☐ No

Please select the training methods that you prefer when learning about *disasters, risk or construction*?

Select all that apply.

☐ Lecture – *Instructor talks to large audience*
☐ Posters – *Informational diagram with photos and text posted in your barangay*
☐ Active Demonstration – *Building or testing a concept, such as hammering nails*
☐ Hand-out Materials – *Booklet or brochure that you can take home to read*
☐ Video – *Recording showing images*
☐ Storytelling – *Use stories from past experience*
☐ Photographs – *Pictures of materials, joints, houses or other construction items*
☐ Maps – *Visual representation of your barangay, such as a hazard map*
☐ Blueprints/Diagrams – *Technical drawings of houses or other infrastructure*

Pre-Yolanda Construction Jobs

Please provide a list of construction jobs you held ***before*** *Typhoon Yolanda. Please leave blank if your work did not involve construction.*

Job Description	Duration (Years, Months)

Post-Yolanda Construction Jobs

Please provide a list of construction jobs you held ***after*** *Typhoon Yolanda. Please leave blank if your work did not involve construction.*

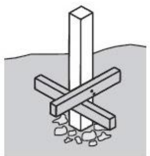
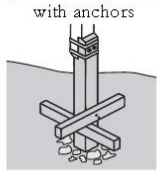
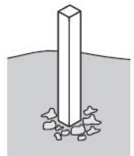
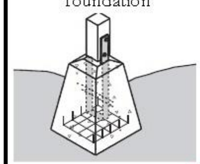
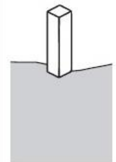
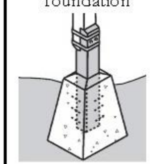
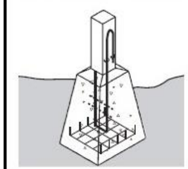
Job Description	Duration (Years, Months)	Currently Employed? (Yes/No)

Researcher Use Only – Do Not Fill Out

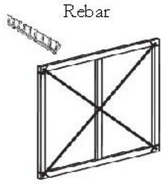
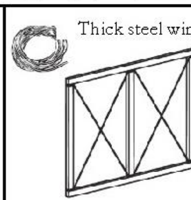
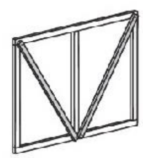
Barangay: ______________________ Respondent Number: ______________

Construction Knowledge

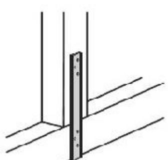
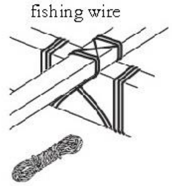
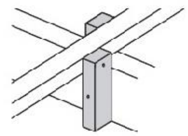
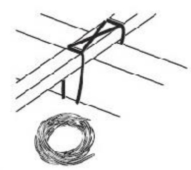
Q1. Please rank the following types of *foundations* from strongest (1) to weakest (7).

Below ground anchors	Treated hardwood post below ground with anchors	Below ground timber post	Steel strap bolted to post on concrete foundation	Above ground timber post	Hardwood post set in concrete foundation	Rebar set into concrete foundation
						

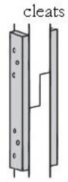
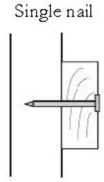
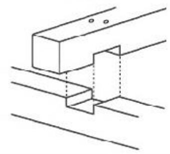
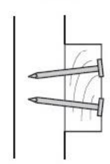
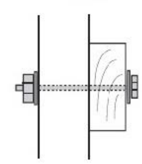
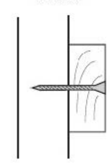
Q2. Please rank the following types of *bracing* from strongest (1) to weakest (4).

Rebar	Nail timber and steel straps	Thick steel wire	Nail timber
			

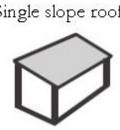
Q3. Please rank the following *tie-downs* from strongest (1) to weakest (4).

Metal strap	Rope or nylon fishing wire	Timber cleats	Thick steel wire
			

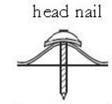
Q4. Please rank the following *joints* from strongest (1) to weakest (6).

Fishplate or cleats	Single nail	Interlock joint and nail	Nails	Bolt	Screw
					

Q5. Rank the *roof types* from best (1) to worst (3) when protecting against strong winds.

Single slope roof	Simple roof	Quatro Aquas
		

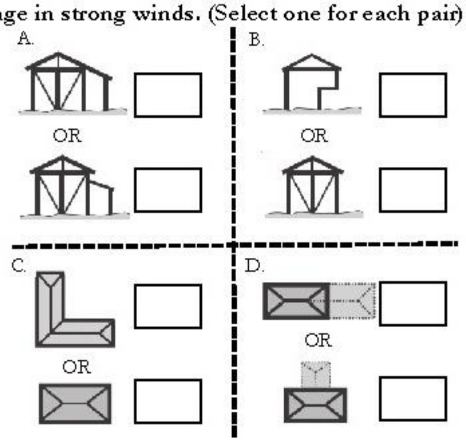
Q6. Rank the *roof connectors* (to secure roof) from strongest (1) to weakest (3).

German wire	Regular nail	Twisted umbrella head nail
		

Researcher Use Only – Do Not Fill Out

Barangay: ______________________ Respondent Number: ______________

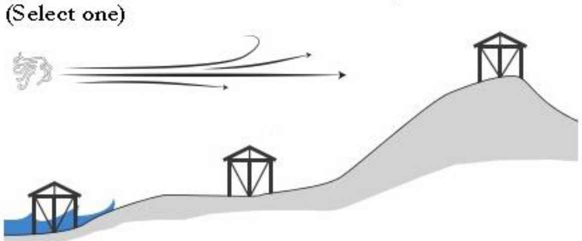
Q7. Choose the *better* building shape that will reduce damage in strong winds. (Select one for each pair)



Q8. Foundations serve the following purpose (Select all that apply):

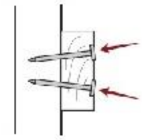
☐ Protects the building from pests - like termites
☐ Keeps the timber away from water so it does not rot
☐ Protects the building from fire
☐ Stops the building from being pushed over
☐ Weights the building down so it can't be sucked up
☐ Stops the building sinking into the ground

Q9. Choose the best location to build your house. (Select one)



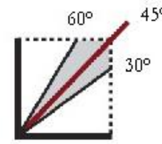
☐ ☐ ☐

Q10. Nailing at an angle will make a joint harder to pull apart.



☐ True
☐ False

Q11. Wall bracing should ideally be placed at what angle?



☐ 60° ☐ 45° ☐ 30°

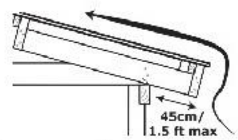
Q12. Roof pitch should ideally be what angle?

☐ ☐ ☐

Q13. Roof edges should have *more* nails.

☐ True
☐ False

Q14. The eaves on a roof should not be longer than 45cm (1.5ft).



☐ True
☐ False

Q15. When a typhoon is approaching, what actions can you take to prepare? (Select all that apply)

☐ Evacuate to a safe location
☐ Disregard early warning information
☐ Create a 'grab bag' with medicines, basic food and important records
☐ Inform relatives/friends where you will evacuate
☐ Wait until the last minute to decide to evacuate
☐ Tie-down your roof with rope or fishing wire

Q16. Did you participate in a *construction training* provided by an NGO or the government after Typhoon Yolanda? (Select one)

☐ Yes ☐ No

If yes, please list:

Training	NGO or Government Agency	Date (Approx.)

Researcher Use Only – Do Not Fill Out

Barangay: ____________________ Respondent Number: ______________

APPENDIX D QUALITATIVE CODING DICTIONARY

This dictionary presents a coding structure that was used to analyze interview data. Each section is outlines key themes and constructs.

Coordination

Processes – *How* people or organizations share knowledge and information. This includes the actual means of communication (e.g. email, meetings, text, etc.), frequency, and context that constitute relations. The nature of individual and inter-organizational conversations is captured here.

> **Barriers and Gaps** – Elements that lead to the breakdown of communication or create a communication void between stakeholders.
>
> **Conflict** – Disagreements (verbal or written) that appear between two or more organizations or individuals. Instances that occur outside of selected housing projects should be included as well to account for influence of these relations.
>
> **Frequency** – The intervals which exchanges occur between projects stakeholders, including but not limited to government agencies, NGOs, and community organizations.
>
> **Mechanisms** – The means through which communication is actually occurring (e.g. email, text, meetings, etc). Coding should also encompass the meaning that is derived from these mechanisms.
>
> **Terminology** – Instances where language is used to navigate organizational relationships, manage risk or convey unique meaning.

Structuring – The contractual and/or relational arrangements an organization, or collection of organizations, employed to divide labor. Focuses on roles and boundaries organizations assemble for project responsibilities.

Geographic – Includes intra- and inter-organizational policies that divide work based on geographic boundaries. May include separation of a single organization's program across multiple barangays or municipalities, or alternatively, the presence of a single of multiple organizations in a barangay.

Roles – Covers the *coordination* roles that are assigned to organizations. Who is the lead agency or organizations? Who is responsible for disseminating information?

Sector – Discussion that appears around how coordination of projects has been divided by sector (e.g. WASH, shelter, roads, etc).

Stakeholder Participation

Decision-Making – Deliberate or unintentional choices made by project stakeholders relating to planning, design, or construction of infrastructure and corresponding management systems.

Initial – Decisions at the onset of phase that control and dictate actions that occur during that time period. These include whether the project should start or continue, location, methods of financing, and future methods of participation by stakeholders.

Ongoing – Made after start of phase that determine allocation of labor, money, and resources.

Operational – Project management decisions that influence staffing or delivery systems of infrastructure. Decisions relate to the operations of the planner, designer, or constructor rather than project elements.

Implementation – The provision of some material or service for a project. This might include such things as labor, transportation, food, or construction materials.

Enlistment – Staffing or labor contributed to project, either directly or indirectly to the project.

Financing – Cash assets provided by stakeholder to support project overhead, materials, labor acquisition, or other project elements.

Resources – Materials, including construction materials, information, land rights, or tools and equipment.

Evaluation – The ability to provide feedback during different stages of a program.

Direct – Actual observed instance of feedback directly to another stakeholder. Code should NOT include instances where the opportunity was presented, but not utilized.

Indirect – Feedback provided to a third party who then relayed information to another stakeholder. Code should NOT include instances where the opportunity was presented, but not utilized.

Training

Materials and Tools – The specific tools that are used to train individuals. This includes the objects used in training – a chalk board, hammer and nails, or training manual.

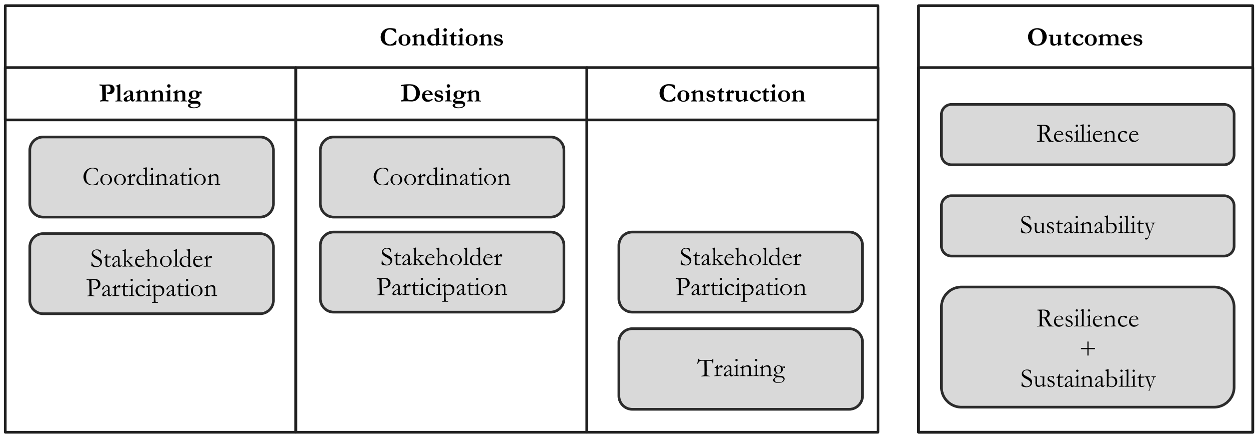
Knowledge Transfer – Educational processes that are employed to teach skills or convey concepts. Structuring of program such as duration, lecturing, or active learning should be included.

Motivations – Rationale and procedures used to gain participation in a training program.

Incentives – Benefits that are included with training program. These could include personal growth, economics, certification, or payment.

Solicitation – Methods that were used to solicit the training program such as posters, word of mouth, or other advertisement.

APPENDIX E QUALITATIVE COMPARATIVE ANALYSIS VARIABLE CALIBRATIONS



Conditions

Planning

Coordination

[PC1] Shelter Sector Participation
[PC2] Cross-Sector Integration
[PC3] Land Rights

Stakeholder Participation

[PSP1] Location Selection
[PSP2] Determination of Aid

Design

Coordination

[DC1] WASH Provision
[DC2] Uniform Design Standards

Stakeholder Participation

[DSP1] Floorplan and Layout
[DSP2] Government Permitting

Construction

Stakeholder Participation

[CSP1] Sweat Equity
[CSP2] Material Procurement
[CSP3] Financial Management
[CSP4] Oversight

Training

[CT1] On-Site Observations
[CT2] Training Method Learning Poles
[CT3] Diversity of Methods

Other Conditions

[O1] Value of Aid

All of the stakeholder participation conditions listed above and *value of aid* are used in Chapter 3. *On-site observations* (CT1) and *training methods* (CT2) were used in Chapter 4. All of the conditions listed above were used in analysis completed for Chapter 5 except for *training method learning poles* (CT2) and *value of aid* (O1).

Outcomes

Resilience

Infrastructure

[R1] Housing
  a. Housing Design
  b. Housing Construction Quality
[R2] Water Access
[R3] Sanitation Access
[R4] Electrical Access
[R5] Education Access
[R6] Medical Care Access
[R7] Transportation
[R8] Evacuation Centers

Governance

[R9] Disaster Management Planning
[R10] Regional Cooperation

Economic

[R11] Household Savings
[R12] Employment

Social

[R13] Social Capital
[R14] Native to Community
[R15] Community Organizations and Mobilization

Sustainability

Economic

[S1] Household Wealth
[S2] Service Interruptions

Social

[S3] Land Ownership
[S4] Shelter Satisfaction

Environmental

[S5] Sanitation System
[S6] Building Material Sourcing

Other Outcomes

[O1] Shelter Adaptations
[O2] Construction Knowledge

Domain Conditions

[DC1] Beneficiary Selection
[DC2] Transportation
[DC3] Electricity Restoration
[DC4] Early Warning Systems
[DC5] Access to Credit
[DC6] Environmental Resilience (e.g. natural barriers)

Housing design (R1a) and shelter satisfaction (S4) were the primary outcomes assess in Chapter 3. Additional analysis of participation pathways to shelter adaptations (O1), social capital (R13), and household savings (R11) is presented in Appendix F. The construction knowledge outcome (O2) was used in Chapter 4. Aggregated outcomes for resilience and sustainability are presented in Chapter 5.

CONDITIONS

Planning: Coordination

Shelter Sector Involvement

This condition was defined by the degree to which project goals aligned other regional shelter organizations, demonstrated by involvement of the primary project shelter organization in the Shelter Cluster. Set membership is based on cluster involvement of the primary organization(s) constructing shelter. In set membership is characterized by organizations that actively participated in the Shelter Cluster. Conversely, organizations which had no involvement constitute out of set membership. Drawing from case knowledge, cluster involvement was largely seen to correlate with alignment of regional shelter strategy. This was partially due to exposure provided to alternative approaches as well as access to the collective knowledge of participating organizations.

Table E-1: Calibration for Shelter Sector Participation

Fuzzy-Set Score	Condition
0	Shelter organization was aware of cluster coordination, but did not attend meetings or report activities.
0.33	Shelter organization was aware of cluster coordination and attended sporadically, but did not send a consistent person to meetings and did not report activities.
0.67	Shelter organization attended shelter cluster meetings but did not send a consistent person. The organization did report on activities to the cluster.
1	Shelter agency actively attended cluster meetings by sending a consistent person and reported activities to the cluster.

Cross-Sector Integration

This condition was defined by the degree to which shelter organizations considered complimentary infrastructure and services such as access to water, education, and healthcare facilities in planning. While alignment of strategy within sectors is important, cross-sector integration also characterizes another important aspect of coordination (Nolte et al. 2012). This is substantiated through theoretical definitions (Comfort and Kapucu 2006) but also empirical evidence (IHC 2011). Cases show that a number of organizations choose to adopt no integration of sectors and the approach was solely on shelter. In contrast, other organizations chose to either accomplish integration under their own programs or by partnering with external organizations. For this condition, planning that excluded other sectors represents out of set membership while in set membership was defined by inclusion of multi-sectoral planning under the implementing shelter organization. Three commonly observed sectors of programming are used with equal weight assigned to each. Integration, defined as documented partnership or intention to provide service in a sector, is the sum of provision of each sector during the planning phase.

Table E-2: Calibration for Cross-Sector Integration

Fuzzy-Set Score	Condition
0.33	Livelihood
0.33	WASH
0.33	Disaster Risk Reduction

Sum of scores for each sector that was present during planning.

Land Rights

A growing area of importance in humanitarian shelter projects is the inclusion of housing, land, and property rights (HLP) into early coordination. It broadly encompasses securing tenure and ensuring that populations are awareness of their occupancy rights. As this often involves multiple stakeholders, such as landlords and local governments, it can be considered a vital aspect of early coordination.

Table E-3: Calibration for Land Rights

Fuzzy-Set Score	Condition
0	Land tenure was not secured for the duration of the shelter assistance provided.
0.7	Tenure secured, but no documentation provided to beneficiary
1	Land tenure was secured in advance of construction.

Planning: Participation

Location Selection

For shelter programs, one of the most essential tasks during planning stages was the selection of site location. The process of involving homeowners into planning efforts being led by government agencies and NGOs varied greatly and provided for differing levels of participation by communities. Given that location is a precursor to subsequent decisions in recovery, location selection is included as one of the components that comprise participation during planning.

Table E-4: Calibration for Location Selection

Fuzzy-Set Score	Condition
0	Households had no say in location of shelter – government or NGO determined *relocation*.
1	Households made decision of location of shelter.

Determination of Aid

Participation of local actors, such as government agencies and homeowners, was primarily determined through requirements of donor agencies. As such, the process for determining priorities and participation of stakeholders during planning was governed by the initial determination of aid. Donor requirements that were more open ended and had mechanisms to facilitate community feedback allowed for participation. In contrast, donor funding that was predetermined excluded stakeholders during these early stages. I distinguish between in set and out of set membership here by whether there was a formal needs assessment conducted within a community prior to distribution of shelter assistance. Further granularity was added by considered whether the assessment was first-hand or second-hand.

Table E-5: Calibration for Determination of Aid

Fuzzy-Set Score	Condition
0	Donor funding or organization pre-determined type of aid and requirements. Households were not involved in assessing needs.
0.7	Implementing organization determined type of aid based on *second-hand assessment* (NGO or government conducted) without consultation with households.
1	Implementing organization determined type of aid based on *first-hand assessment* (NGO or government conducted) with consultation with households.

Design: Coordination

Provision of WASH

It is critical that design of infrastructure be coordinated across infrastructure sectors. Electrical supply, and for the most part transportation infrastructure, was already in place and operational prior to the construction of other infrastructure assets observed in recovery. Shelter, water supply, and sanitation infrastructure were the most common ground where coordination was required, given the state of other infrastructure. As such, I only examine these three sectors for this condition. Here I consider design to be the technical and operational plans by either the shelter organization or by another organizations working in the community.

Table E-6: Calibration for Provision of WASH

Fuzzy-Set Score	Condition
0	Water supply and sanitation facilities were not included in shelter design.
0.33	Water supply OR sanitation facilities were provided in shelter design.
0.67	Design included access to water supply AND *shared* sanitation facilities.
1	Design included access to water supply AND *private* sanitation facilities.

Uniform Design Standards

The presence of uniform design standards was one of the hallmarks of the Shelter Cluster in the response. Their 8 Key Messages proved one method to evaluate whether an organization's shelter design aligned with other organizations. Out of set membership consisted of lacking adherence to the cluster guidelines, while in set membership consisted of adopting messaging in programming. Documentation distributed to beneficiaries and internally within organizations was the primary means of assessing this adoption.

Table E-7: Calibration for Uniform Design Standards

Fuzzy-Set Score	Condition
0	Few, if any, Shelter Cluster messages were considered in the design of shelter.
0.33	Minor adaptations were included in shelter design, but significant recommendations outlined in Shelter Cluster guidance were omitted.
0.67	Major design elements recommended by the Shelter Cluster, such as bracing, were included in the design of shelter.
1	Household or organization developed design in-line with all Shelter Cluster messaging.

Design: Participation

Floorplan and Layout

Household participation ranged from no input to individual design consultations. I include large community meetings as the intermediate out of set value due to the nature of these meetings to suppress of the voice of minorities in communities. For in set membership, I distinguish between input on plans that were already completed and open ended dialogue with homeowners on features. When plans were already developed this frequently led to homeowners withholding opinions due to concern over losing aid support. Overall, out of set membership is distinguished by one-directional communication whereas in set membership is characterized by bi-directional communication between the homeowner and the implementing organization.

Table E-8: Calibration for Floorplan and Layout

Fuzzy-Set Score	Condition
0	Households were never consulted on the floorplan and layout of the shelter.
0.33	Households were consulted through a large community meeting to discuss housing features.
0.67	Households were provided floor plan and asked preferences, such as location of doors and windows, that were then included in the final design.
1	Households were asked to actively participate in the development of floorplans and had control over final design decisions.

Government Permitting

Another vital element of stakeholder participation during design was the consultation of local government agencies. This was most commonly accomplished through the municipal or city office.

In many cases organizations may have approached local governments, but these were often referred to as ‘courtesy calls’ and lacked and real discourse. As a result, I define in set membership as written evidence of acknowledgement by a local municipality or city agency of shelter plans. This often signaled that additional informal feedback was also offered on designs, location, beneficiary selection, and other program details.

Table E-9: Calibration for Government Permitting

Fuzzy-Set Score	Condition
0	Municipal government did not provide documented permission on design of shelter solution.
1	Municipal government was consulted prior to construction, provided recommendations and written approval.

Construction: Participation

Sweat Equity

Involvement of beneficiaries in construction labor is one of the primary forms of participation seen in development projects and disaster recovery programs. Here I define in set membership as required contribution of at least some construction labor. Site works, just as clearing and grubbing are considered, but are included as slightly out of the set. I do not distinguish whether the labor was skilled or un-skilled.

Table E-10: Calibration for Sweat Equity

Fuzzy-Set Score	Condition
0	Household was not involved in construction labor.
0.33	Household contributed minimal labor during construction. Tasks were confined to site works, not construction.
0.67	Homeowner contributed minimal labor to construction. Tasks involved construction, not just site work.
1	Homeowner contributed significant labor to construction. Tasks may have involved a combination of construction and site work.

Material Procurement

Another task that commonly arose during construction that required beneficiary participation was the procurement of construction materials. This aligns with theoretical notions of participation by means of operational tasks required to implement projects. In set membership is defined by evidence of household involvement in receiving, inspecting, and certifying materials. In some cases, this may have also involved transportation of materials. In contrast, if the organization acquired all materials this is considered out of set membership.

Table E-11: Calibration for Material Procurement

Fuzzy-Set Score	Condition
0	Homeowner was not involved in the material procurement process.
1	Homeowner was required to receive, inspect, and certify materials from organization, provide protection during construction, and organize transportation, if required.

Financial Management

Separate from procurement, beneficiaries in some cases were asked to manage project finances. This involved being provided a total cash sum to manage and control expenses through acquiring labor or materials. This is distinguished from material procurement in that homeowners were in some cases asked to procure materials through established routes, such a designated vendor at pre-established prices, whereas financial management denotes freedom of selection.

Table E-12: Calibration for Financial Management

Fuzzy-Set Score	Condition
0	Beneficiary was not responsible for any aspect of managing shelter construction finances.
0.7	Beneficiary was responsible for managing labor expenses for shelter construction or a component of material expenses.
1	Beneficiary had significant role in managing shelter budget including labor and materials.

Oversight

Past literature (Jordan et al. 2016) has identified both organizational and beneficiary oversight of construction to be an important element of participation. I base the calibration for this condition primarily on the level of action taken in response to construction inspections. Out of set membership is the absence of the homeowner during construction and in set membership is inspections by both the homeowner and organization at major milestones, such as foundation, wall and roof completion. A third fuzzy value is added slightly out of set for inspections that were conducted but lacked action to correct deficient construction.

Table E-13: Calibration for Oversight

Fuzzy-Set Score	Condition
0	No inspection of construction.
0.3	Organization and household members inspected shelter at sporadic milestones, however no action was observed on items requiring rework or modification.
1	Organization and household members inspected shelter at major milestones. Action was observed on items that required rework or modification.

Construction: Training

On-Site Observation

While many organizations emphasize the importance of transferring knowledge on safer building principles to homeowners, implementing agencies typically assume that this has to occur through direct and intentional learning activities or materials. In our analysis of construction knowledge across households, I found statistically significant differences in construction knowledge for those households that were present at the construction site. Our interview data from households suggests that in addition to intentional training activates, households acquired new knowledge through observation of new construction techniques applied. As such, I include on-site observations a condition of training. To structure our set, I identified two groups of cases. Out of set membership is defined as lacking presence of the household during construction. This was most common for relocation programs where household did not witness construction and moved after completion of the shelters. In contrast, the ability to observe new techniques being used and ask questions to carpenters and masons defines in set membership.

Table E-14: Calibration for On-Site Observation

Fuzzy-Set Score	Condition
0	Household was NOT present during shelter construction.
1	Household was present during shelter construction.

Training Method Learning Poles

I explored training methods through the lens of experiential learning theory. Several models of experimental learning exist, however the Kolb model is one of the mostly widely used and provides a clear framework to examine learning processes (Kolb 1984). The model proposes 4 learning 'poles' that include: (a) concrete experience; (b) reflective observation; (c) abstract conceptualization and; (d) active experimentation. I sought to understand and test whether training methods that corresponded to these had an impact on construction knowledge. While I could have alternatively selected individual training methods, this would have increased our logic space by growing the number of conditions considered, whereas Kolb's four poles provide greater parsimony toward underlying characteristics of training methods. For each of the four conditions corresponding to each respective pole, I opted to use a crisp set that was defined on the presence or absence of content in that given area.

Table E-15: Calibration for Training Method Learning Poles

Fuzzy-Set Score	Condition
0	Project involved training methods that did NOT correspond to: (a) concrete experience; (b) reflective observation; (c) abstract conceptualization and; (d) active experimentation
1	Project involved training methods that corresponded to: (a) concrete experience; (b) reflective observation; (c) abstract conceptualization and; (d) active experimentation

Diversity of Training Methods

Experiential learning theory (ELT) posits that individuals learn through discovery and experience. Applying this lens to post-disaster training programs, I identified characteristics of formal training programs, mapping these onto the 4 poles used in ELT, including: (a) concrete experience; (b) reflective observation; (c) abstract conceptualization; and (d) active experimentation. As each of these stages is important, and collectively they act as a learning cycle, I draw from previous research to suggest that in set membership is defined when training methods touch on all four poles of ELT. Conversely, the absence of training signifies out of set membership. I determined our crossover point by exploring differences in methods and construction knowledge, finding that the combination methods that touches on three ELT poles signified a change in construction knowledge.

Table E-16: Calibration for Diverse Training Methods

Fuzzy-Set Score	Condition
0	No training was provided to homeowners.
0.33	Training methods used 2 of the 4 experiential learning theory poles.
0.67	Training methods used 3 of the 4 experiential learning theory poles.
1	Training methods were used that covered all four poles of the Kolb Learning Style Inventory

Other Conditions

Value of Aid

Theoretically, the level of assistance should have an impact on project outcomes as greater resources have been shown to be a previous condition aiding recovery (Jordan et al. 2016). Average values of shelter assistance across projects were considered, including the value of any labor or materials provided. The value of technical assistance (e.g. training) was excluded from value estimates. Anchor points were established using Shelter Cluster estimates with out of set membership linked to the value needed for basic repairs (P20,000) and in set membership tied to the estimated average cost for a new permanent shelter (P185,000). The crossover point was set at P85,000, or the average value of a single room core shelter.

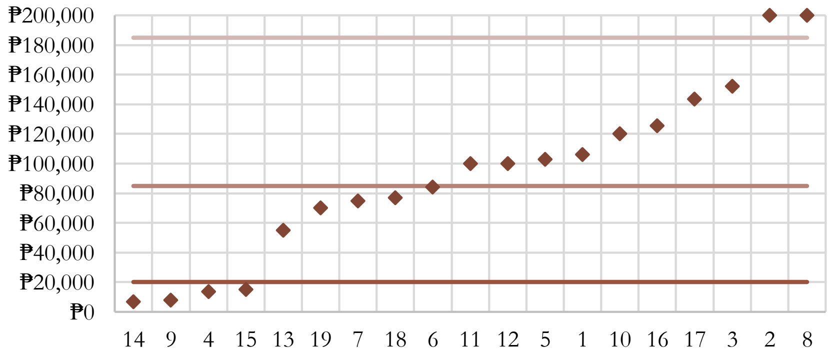


Figure E-1: Threshold and Crossover Points in Direct Calibration for Value of Aid

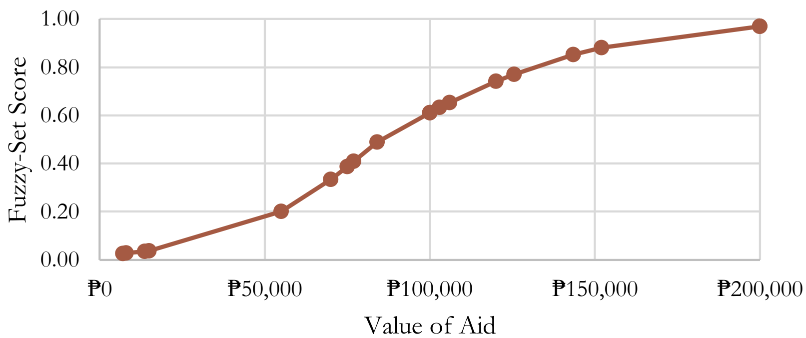


Figure E-2: Calibration for Value of Aid

Outcomes

Resilience

Overall resilience is taken as the average of infrastructure, governance, economic, and social dimensions. Each sub-condition is weighted evenly within each respective dimension.

Infrastructure

Shelter Design

Housing stock has been shown to be key aspect of community resilience for its role in supporting social and economic recovery (Peacock et al. 2007). This condition combines shelter design and construction quality to assess housing units within a community. The *minimum* value of the two sub-conditions is taken as a combination of sound design principles and quality in construction lead to the ability to resist typhoon and earthquake hazards. The absence of one limits the overall state.

Shelter Design

Past studies have relied on contextually bounded indicators of housing resilience (e.g. age of structures) (Cutter 2016). This is the result of different housing archetypes having inherently different properties in the face of hazards. Drawing from shelter technical guidance produced by the Shelter Cluster, I compiled a composite indicator of shelter design based on 7 of the 8 key messages that were produced in the aftermath of Haiyan (Opdyke et al. 2016). These were based on the following shelter components: (1) foundations; (2) tie-downs; (3) bracing; (4) joints; (5) roofing; (6) site location; (7) shape. Individual components within each category were assessed based on structural observations conducted at 30 months' post-disaster. A sum of individual message sets was used to calculate an overall score for each case. I define out of set membership as averaging 3 of the messages, the crossover point as 5 messages, and in set as all 7 messages.

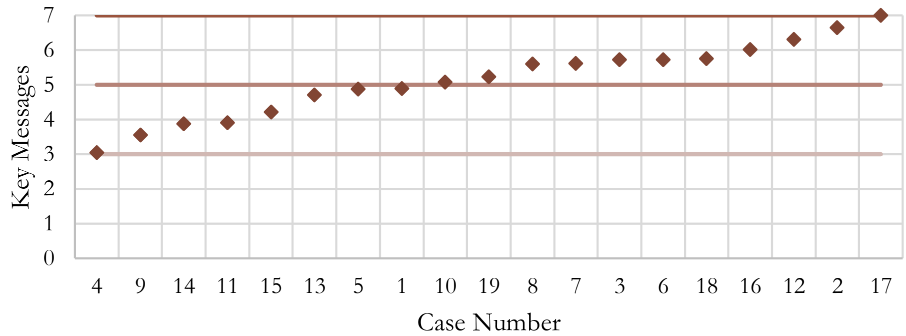


Figure E-3: Threshold and Crossover Points in Direct Calibration for Shelter Design

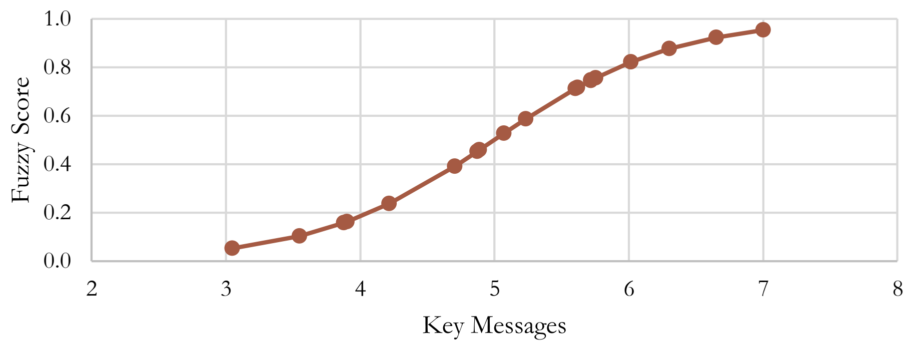


Figure E-4: Calibration for Shelter Design

Data Source: survey questions (foundation type, wall type, connections types, and roofing type), observations

Notes: I initially tried to simplify calibration based on building materials and key components (e.g. concrete foundations), however this did not capture small deviations and the composite (a revision of the earlier assessment of designs) proved more nuanced. The resilience of designs becomes complex when considering the robustness of different materials compared to the ability to rapidly repair damage. There is a need to expand future research to understand engineered resilience. For example, shelters can sustain planned damage (such as wall blow outs) and these are potentially easier to rebuilt in high intensity hazards. There is strong evidence from indigenous building techniques to support these safe failures in housing. Despite these claims, repeated reconstruction can be considered a major barrier to long term development of communities.

Table E-17: Calibration of Shelter Design Components

Key Message	Sub-Category	Set Score	Description	Number of Cases	Percent Adoption
Foundation		0	Above or below ground timber post	3	16%
		0.33	Below ground timber anchors	1	5%
		0.67	Rebar tie-downs in concrete foundation	7	37%
		1	Steel strapped embedded in concrete foundation	8	42%
Tie-Down	Floor Joists	0	No connectors	0	0%
		0.7	Nailed	11	58%
		1	Metal strapping	0	0%
		N/A	Not Applicable (e.g. concrete floor)	8	42%
	Truss-Post Connections	0	No connectors	0	0%
		0.7	Nailing or rebar	14	74%
		1	Metal strapping/bolts	5	26%
	Rafter-Purlin Connection	0	No connection tie-downs	3	16%
		0.7	Wire/rope ties or timber cleats	8	42%
		1	Metal strapping/bolts	8	42%
Bracing	Trusses	0	No bracing	3	16%
		0.33	Steel wire/rebar bracing	1	5%
		0.67	Nailed timber	11	58%
		1	Strapped/bolted timber	4	21%
	Roof	0	No bracing	16	84%
		0.33	Steel wire/rebar bracing	0	0%
		0.67	Nailed timber	1	5%
		1	Strapped/bolted timber	2	11%
	Silts	0	No bracing	3	16%
		0.33	Steel wire/rebar bracing	0	0%
		0.67	Nailed timber	4	21%
		1	Strapped/bolted timber or not applicable	12	63%
	Wall	0	No bracing	8	42%
		0.33	Steel wire/rebar bracing	0	0%
		0.67	Nailed timber	8	42%
		1	Strapped/bolted timber	3	16%
	Angle	0	$\theta<30$ or $\theta>60$	7	37%
		1	$30<\theta<60$	12	63%
Joints	Joint Extensions	0	No extensions	13	68%
		1	Extension past post or not applicable	6	32%
	Notching	0	Notched more than 1/3	1	5%
		1	Notched less than 1/3 or not applicable	18	95%
	Nailing Offset	0	Nailing in-line	9	47%
		1	Nailing offset or not applicable	10	53%
	Nailing Angle	0	Nailing is straight	10	53%
		1	Nailing is at angle, screws or not applicable	9	47%
	Horizontal Joints	0	No connectors used	3	16%
		0.7	Nailing	8	42%
		1	Fishplate, straps, bolts or not applicable	8	42%
	Gusset Plates	0	No gusset plates used	10	53%
		1	Trusses include timber or steel gusset plates or not applicable	9	47%

Table E-17: Calibration of Shelter Design Components (cont)

Key Message	Sub-Category	Set Score	Description	Number of Cases	Percent Adoption
Roofing	Eaves	0	Longer than 45cm/1.5ft	3	16%
		1	Shorter than 45cm/1.5ft	16	84%
	Pitch	0	θ<15 or θ>50	2	11%
		1	15<θ<50	17	89%
	Edge Nailing	0	No additional nailing provided	8	42%
		1	Additional nailing provided or not applicable	11	58%
	Overlapping Sheets	0	Sheets do not overlap	2	11%
		1	Sheets overlap or not applicable	17	89%
	Nailing	0	Regular nailing	1	5%
		0.7	Umbrella nail or wire	11	58%
		1	Twisted umbrella nail head or roofing screw	7	37%
	Shape	0	Monoslope	0	0%
		0.7	Gable	11	58%
		1	Hipped ("Quatro Aquas")	8	42%
Site	Flooding/ Storm Surge	0	Floor not raised and prone to flooding/storm surge	3	16%
		1	Silted house or not applicable	16	84%
	Rockfall/ Slopes	0	Prone to landslides/rockfall	0	0%
		1	Safe distance from landslides/rockfall or not applicable	19	100%
	Debris	0	Within distance of falling trees or other debris	3	16%
		1	Safe distance from falling debris or not applicable	16	84%
	Wind	0	Exposed to coastal winds or high on mountain	2	11%
		1	Inland or protected from winds	17	89%
Shape	Overhangs	0	Overhang on at least one wall face	0	0%
		1	No overhangs	19	100%
	Layout	0	Irregular shape	2	11%
		1	Rectangular or square shape	17	89%
	Length	0	Building at least twice as long as wide	0	0%
		1	Building does not have side more than twice width	19	100%
	Awnings	0	Awnings attached to main roof	4	21%
		1	Awnings separate from main roof	15	79%
	Building Groups	0	Housing groups trap wind	1	5%
		1	Housing groups allow for adequate wind flow	18	95%
Preparedness	Evacuation	0	No evacuation center or plan	11	58%
		1	Designated evacuation center and plan	8	42%
	Communication	0	Lacking early warning systems	0	0%
		1	Radio, television or other source of early warning	19	100%
	Supplies	0	No supplies	15	79%
		1	Medical supplies, documentation, food and/or clothing prepared	4	21%

Table E-18: Composite Shelter Design Assessment

Case Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Overall Design (possible 7)	4.89	6.65	5.72	3.05	4.87	5.72	5.62	5.60	3.55	5.07	3.90	6.30	4.70	3.88	4.22	6.02	7.00	5.76	5.24
Calibration	0.46	0.92	0.75	0.05	0.45	0.75	0.72	0.71	0.10	0.53	0.16	0.88	0.39	0.16	0.24	0.82	0.95	0.76	0.59
Foundation	0.67	1.00	1.00	0.00	0.67	1.00	1.00	0.67	0.00	0.67	0.67	1.00	0.67	0.33	0.00	1.00	1.00	0.67	1.00
Tie-Down	0.70	0.85	0.70	0.85	0.70	0.80	0.70	1.00	0.70	0.70	0.70	0.90	0.47	0.47	0.35	0.90	1.00	0.70	0.90
Floor Joists	N/A	N/A	0.70	N/A	N/A	0.70	0.70	N/A	0.70	N/A	0.70	0.70	0.70	0.70	N/A	0.70	N/A	0.70	0.70
Truss-Post Connections	0.70	0.70	0.70	0.70	0.70	0.70	0.70	1.00	0.70	0.70	0.70	1.00	0.70	0.70	0.70	1.00	1.00	0.70	1.00
Rafter-Purlin Connection	0.70	1.00	0.70	1.00	0.70	1.00	0.70	1.00	0.70	0.70	0.70	1.00	0.00	0.00	0.00	1.00	1.00	0.70	1.00
Bracing	0.33	1.00	0.40	0.20	0.33	0.60	0.60	0.60	0.20	0.47	0.13	0.67	0.33	0.60	0.47	0.73	1.00	0.60	0.60
Trusses	0.67	1.00	1.00	0.00	0.67	0.67	0.67	0.00	0.00	0.67	0.67	0.67	0.67	0.33	0.67	1.00	1.00	0.67	0.67
Roof	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
Silts	1.00	1.00	1.00	1.00	1.00	0.67	0.67	1.00	1.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	1.00	0.67	0.67
Wall	0.00	1.00	0.00	0.00	0.00	0.67	0.67	1.00	0.00	0.00	0.00	0.67	0.00	0.67	0.67	0.67	1.00	0.67	0.67
Angle	0.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Joints	0.28	1.00	1.00	0.17	0.17	0.62	0.78	1.00	0.28	0.50	0.28	0.83	0.50	0.28	0.45	0.83	1.00	0.83	0.12
Joint Extensions	0.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
Notching	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Nailing Offset	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00
Nailing Angle	0.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00
Horizontal Joints	0.70	1.00	1.00	0.00	0.00	0.70	0.70	1.00	0.70	1.00	0.70	1.00	0.00	0.70	0.70	1.00	1.00	1.00	0.70
Gusset Plates	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	0.00
Roofing	0.90	1.00	0.62	0.28	1.00	0.95	0.78	0.78	0.57	0.73	0.57	0.90	0.73	0.90	0.95	1.00	1.00	0.95	0.62
Eaves	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Pitch	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Edge Nailing	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Overlapping Sheets	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Nailing	0.70	1.00	0.70	0.00	1.00	0.70	1.00	1.00	0.70	0.70	0.70	0.70	0.70	0.70	1.00	1.00	1.00	0.70	0.70
Shape	0.70	1.00	1.00	0.70	1.00	1.00	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	1.00	1.00	1.00	1.00

Table E-18: Composite Shelter Design Assessment (cont)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Overall Design (possible 7)	4.89	6.65	5.72	3.05	4.87	5.72	5.62	5.60	3.55	5.07	3.90	6.30	4.70	3.88	4.22	6.02	7.00	5.76	5.24
Calibration	0.46	0.92	0.75	0.05	0.45	0.75	0.72	0.71	0.10	0.53	0.16	0.88	0.39	0.16	0.24	0.82	0.95	0.76	0.59
Site	1.00	1.00	1.00	0.75	1.00	0.75	0.75	0.75	1.00	1.00	0.75	1.00	1.00	0.50	1.00	0.75	1.00	1.00	1.00
Flooding/Storm Surge	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00
Rockfall/Slopes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Debris	1.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Wind	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00
Shape	1.00	0.80	1.00	0.80	1.00	1.00	1.00	0.80	0.80	1.00	0.80	1.00	1.00	0.80	1.00	0.80	1.00	1.00	1.00
Overhangs	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Layout	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Length	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Awnings	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00
Building Groups	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Preparedness	0.33	0.67	0.33	0.33	0.67	0.33	0.33	0.67	0.33	0.67	0.33	0.33	1.00	0.67	0.33	1.00	0.67	0.67	0.67
Evacuation	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Communication	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Supplies	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	1.00	0.00

Shelter Construction Quality

In contrast to housing design, construction quality assesses the adherence to standards for the type of material and building system used. There are two aspects that are used to evaluate quality of construction: (1) quality of building materials and (2) defects in construction. Weak materials, such as inappropriately selected coconut lumbers (e.g. young coconuts trees or inside cuts) are unable to carry wind and seismic loads. Defects in construction include, but are not limited to, missing reinforcement in masonry construction, missing connection elements, or lack of nailing. Of the two criteria used, construction defects are used as the primary measure of in set and out of set membership as this has a greater influence over structural capacity. Poor building materials may degrade quickly, but do not have as large an impact during initial years of use – this is also less of a concern for temporary or transitional housing, assuming that these shelters will be replaced or upgraded.

Table E-19: Calibration for Housing Construction Quality

Fuzzy-Set Score	Condition
0	Houses are constructed using sub-standard materials and there are significant defects in the construction.
0.33	Housing units use quality materials, but significant defects are present in the construction.
.67	Housing units use standard materials, but no defects are present in construction
1	High quality materials are used and no defects are found in construction.

Data Source: interviews (from during construction) and observations

Notes: The reason for adding quality was inability to explain differences in material types. For example, masonry should be more resilient (to wind at least), yet construction quality was often lacking.

Water Access

This condition is based on access to, and capacity of, drinking, washing, and bathing water. Sphere standards specify that every household should have a water point within 500 meters (Sphere Project 2011). On average, this equates to approximately a 10-minute walk time. In addition to distance to source, the ability of a water source to meet a household's needs was also included using the Sphere standard of 15 liters/person/day. The ability of a water source must meet a household's needs during all months of the year, but not necessarily at any given time during the day. Water quality was excluded as no reliable data sources were available.

Table E-20: Calibration for Water Access

Fuzzy-Set Score	Condition
0	Water source is over 10 minutes walking distance and quantity provided is less than 15 liters/person/day.
0.33	Water source is under 10 minutes walking distance but quantity provided is less than 15 liters/person/day.
0.67	Water source is over 10 minutes walking distance but quantity provided is 15 liters/person/day or more.
1	Water source is within 10 minutes walking distance and quantity provided is 15 liters/person/day or more.

Data Source: survey questions – drinking water and washing/bathing water, categorical data (0-1 minutes, 1-3 minutes, 3-5 minutes, 5-10 minutes, over 10 minutes), observations, and field notes (questions following survey questions on drinking water)

Notes: Initially I separated drinking water and washing/bathing water, however there was little variation between the two. There were slight differences in access to sufficient quantity, but the distances to sources (they are often different) were usually the same. Type of source (communal tap, private tap, etc) was initially used. It was too hard to distinguish between types of sources and how one is more resilient over another.

Sanitation Access

The absence of sanitation systems poses significant threats to community health, particularly in post-disaster contexts. The rise of cholera in Haiti after the 2010 earthquake is one example of detrimental impacts of outbreaks of disease. Improved access to sanitation limits the exposure to these risks. As sanitation systems are sub-surface, potential damage is typically limited to superstructures and thus the limiting factor is not necessarily the type or size of system, but access to such systems. The former characteristics (size and type) play a larger role in influencing maintenance.

Table E-21: Calibration for Sanitation

Fuzzy-Set Score	Condition
0	Open defecation is predominant sanitation practice
0.3	Households share a toilet
1.0	Households have private access to a toilet

Data Source: survey question on access to sanitation (private toilet (attached), private toilet (detached), shared toilet with neighbor, communal toilet, open defecation)

Notes: I initially considered using the type of system (septic tank, pit latrine, etc), but this likely has greater influence over maintenance practices. Further, access to sanitation better captures the quantity (redundancy and robustness) and ability to reconstruct if damaged since damage is usually only to the superstructure (resourcefulness and rapidity).

Electrical Access

The ability of households to access power generation through the grid. Power access is often inextricably linked to other infrastructures, such as water systems, and has been shown to be important for economic activity. While restoration of power was relatively uniform across all communities studied, there were variations observed in the ability of households to connect to the power grid. As such, the set was structured around lack of access, slightly in set was defined as shared connections, and full membership was private connections.

Table E-22: Calibration for Electrical Access

Fuzzy-Set Score	Condition
0	Households have no access to electrical connection
0.7	Households predominantly share a power connection with a neighbor or collective of neighbors.
1	Households have private electrical connections

Data Source: survey question on power access (private connection, shared connection or no access to power)

Notes: While there are dozens of other metrics for measuring power system resilience, the impact of Hiayan demonstrated that the limiting factor in restoring power to communities was household connections. Electrical lines were replaced within three months, however household connections and power agreements between homeowners and power suppliers have taken years to restore. The generation capacity itself is fairly consistent across all regions studied and can be considered a domain condition. Further, I previously included a separate condition for 'alternative power systems' that could act as backups, such as solar lights. Such a large percentage of these were non-functional and there was quite a bit of overlap with simple access to electricity that this separate condition did not make sense.

Education Access

Travel times to both primary and high schools are used to assess education facility resilience. As all of the schools built after Haiyan used the same standard plan, there was nearly no difference in level of design across facilities. As a result, distance to the nearest school was the limiting factor when determining resilience of educational facilities.

Table E-23: Calibration for Education Access

Fuzzy-Set Score	Condition
0	Nearest primary and high school is more than 30 minutes
0.33	Nearest primary and high school is between 15 minutes to 30 minutes.
.67	Nearest primary and high school is between 5 minutes and 15 minutes.
1	Nearest primary and high school is less than 5 minutes.

Data Source: survey question asked to barangay officials on travel times to nearest primary and high schools

Notes: The actual design of schools is considered to be a domain condition because the Philippine Department of Education uses standardized designs nationally for all primary and high schools. The exception to this is private schools, however the majority of households surveyed could not afford to send their students to these facilities.

Medical Care Access

In order to evaluate medical care access, the travel time to the nearest hospital is used. As all barangays studied had barangay health centers, this was a domain condition and does not represent access to medical care beyond simple injuries or illnesses.

Table E-24: Calibration for Medical Care Access

Fuzzy-Set Score	Condition
0	Nearest hospital is more than 1 hour.
0.33	Nearest hospital is between 30 minutes to 1 hour.
.67	Nearest hospital is between 15 minutes and 30 minutes.
1	Nearest hospital is less than 15 minutes.

Data Source: survey question asked to barangay officials on travel times to nearest hospital

Notes: Travel time is used in place of distance to take into consideration means of transportation and income. Many households were required to take Jeepneys due to income constraints. Further road infrastructure often extended times to reach facilities. I initially considered direction calibration, but it was not required due to grouping of answers provided by barangay officials.

Transportation

The quality of infrastructure supporting transportation modes is an important aspect of transportation system resilience. Entirely paved roads are considered in set as these are more robust to weather-related hazards. The quality of these roads, reflected by observations of cracking and rutting, is also used to measure the performance of roads infrastructure.

Table E-25: Calibration for Quality of Roads

Fuzzy-Set Score	Condition
0	Barangay roads are of poor quality and are either dirt or show significant signs of cracking.
0.33	Barangay roads are of below average quality and are a mix of dirt and/or paved, with minor signs of cracking or rutting.
0.67	Barangay roads are of above average quality and are a mix of dirt and/or paved, with no signs of cracking or rutting.
1	Barangay roads are of excellent quality and are all paved with minimal sizes of cracking or rutting.

Data Source: survey question asked to barangay officials on quality of barangay roads (excellent, above average, below average, poor), observations

Evacuation Centers

Here I consider all sites that provide safe shelter in the face of hazards an evacuation site. These includes houses, schools, barangay buildings, commercial buildings. Natural formations, such as caves, are excluded because of rare use and late evacuation times. There is significant evidence from past literature to suggest that evacuation sites must be situate within 500 meters of households in order to be viable (Mallick et al. 2011). Evacuation centers more than 500m away were also found to be commonly unused in Typhoon Ruby one year after Yolanda.

Table E-26: Calibration for Evacuation Centers

Fuzzy-Set Score	Condition
0	Distance to nearest safe evacuation site is more than 500m.
1	Distance to nearest safe evacuation site is less than 500m.

Data Source: survey question asked to barangay officials on evacuation sites, observations

Governance

I measure resilient governance as consisting of effective and proactive planning as well as regional cooperation. Both are theorized in literature to be of equal importance so the two conditions are averaged with equal weight.

Disaster Management Planning

Frequently cited in literature as a means to reduce risk, disaster management planning improves the ability of community response through preemptive measures. In particular, I use evacuation drills as a means to measure efforts to prepare for future hazards. While written disaster management plans are a first step in analyzing risks, evacuation drills demonstrate putting these plans into practice. I differentiate between drills that were initiated by the barangay and external organizations as those initiated internally are theorized to have a higher chance to being sustained.

Table E-27: Calibration for Disaster Management Planning

Fuzzy-Set Score	Condition
0	Barangay has not held any evacuation drills in the last year.
0.8	Barangay has held evacuation drill in the last year with assistance from municipal government or non-governmental organization.
1	Barangay has initiated its own evacuation drill in the last year without assistance from external organization.

Data Source: interviews, survey question (participation in training event in last year)

Regional Cooperation

Established relations with neighboring barangays and municipalities allows for sharing of resources during a disaster event. Further, understanding of disaster management procedures allows for local governments to compliment neighboring efforts, support gaps in response, and strengthen core competencies. This is represented through the sharing of disaster management plans, either verbally or in writing. Cooperation also includes joint meetings to discuss disaster management.

Table E-28: Calibration for Regional Cooperation

Fuzzy-Set Score	Condition
0	Low cooperation between neighboring barangays and municipality and the barangay has NOT shared its disaster management plan with neighboring barangays and its municipality.
0.33	Low cooperation between neighboring barangays and municipality but the barangay has shared its disaster management plan with neighboring barangays and its municipality.
0.67	Strong cooperation between neighboring barangays and municipality but the barangay's disaster management plans have NOT been shared with neighboring barangays and its municipality.
1	Strong cooperation between neighboring barangays and municipality and barangay has shared its disaster management plan with neighboring barangays and municipality.

Data Source: interviews, survey questions to barangay officials: (1) The disaster management culture with our municipality and neighbor barangays is collaborative. (strongly disagree, disagree, agree, strongly agree) (2) We have shared our disaster management plan with (1) neighbor barangays and (2) municipality.

Economic

Household Savings

Average savings of households in a community represents a measure of economic robustness and ability to rapidly rebound from a shock. Cash provides useful as it can be used fluidly to purchase needed resources in the event of a disaster. The Philippines Statistics Authority reported that in 2015 the average family of five would need P1,582 per week in order to meet basic food needs (Perez 2016). Further, in area studied (Region VIII of the Philippines), the per capita poverty threshold was determined as P21,304 per year, or P317 per day for a family of five individuals (Perante 2016). I used these amounts to structure our set, P1,582 for full membership, P317 for the crossover point, and P0 as full non-membership. Practically, I posit that savings should cover at least one week of essential needs and that the crossover from no savings rests at one day of income at the poverty threshold. Households that have savings are able to move beyond living on simple daily income.

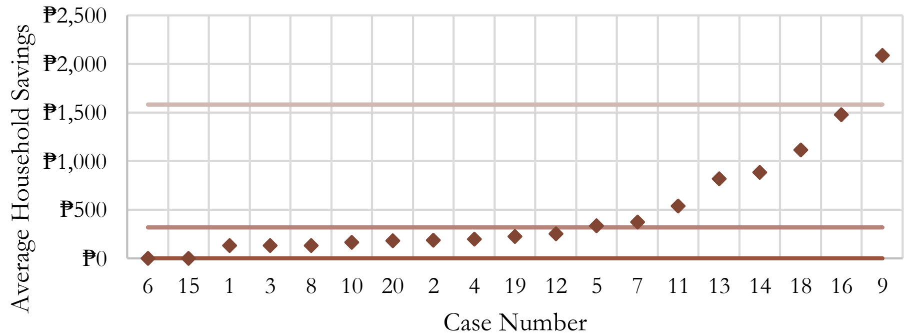


Figure E-5: Threshold and Crossover Points in Direct Calibration for Household Savings

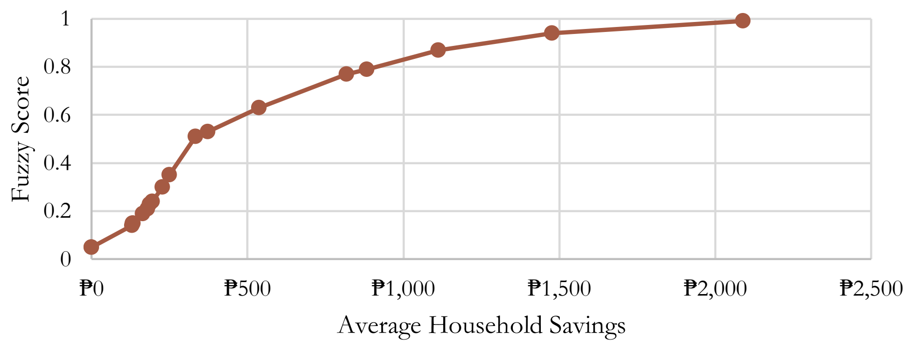


Figure E-6: Calibration for Household Savings

Data Source: survey question to households asking current savings

Notes: I did not include household income here as it is a better indicator of long-term sustainability in relation to infrastructure maintenance. Further, higher incomes are potentially tied to industries that inherently are less resilient (e.g. coconut farming). Access to credit is a domain conditions since no less than two-thirds of households in a community had access and 65% of all communities had more than 80% of households with access to credit.

Employment

Past studies have emphasized the importance of employment as an indicator of economic robustness. Here I draw from data on labor force participation rates of adults between working ages of 18 and 65. I use the most recent (2016) Philippine labor force participation rates for Region VIII, 64.3%, where the majority of communities were located as the crossover point (Philippine Statistics Authority

2017b). Region VII, where the communities in Cebu were located, had a similar labor force participation rate of 65.3%. Non-membership is considered to be 50% and in set membership considered as 80%. Other studies have suggested that women's participation in the workforce could also be considered an indicator of economic resilience (Cutter 2016), however I found this to be highly contextual to culture and is less applicable to patriarchal societies where women take a more central role in household tasks.

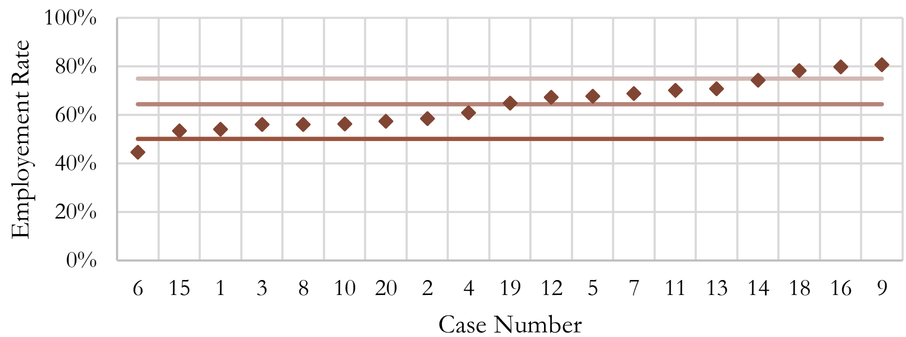


Figure E-7: Threshold and Crossover Points in Direct Calibration for Employment

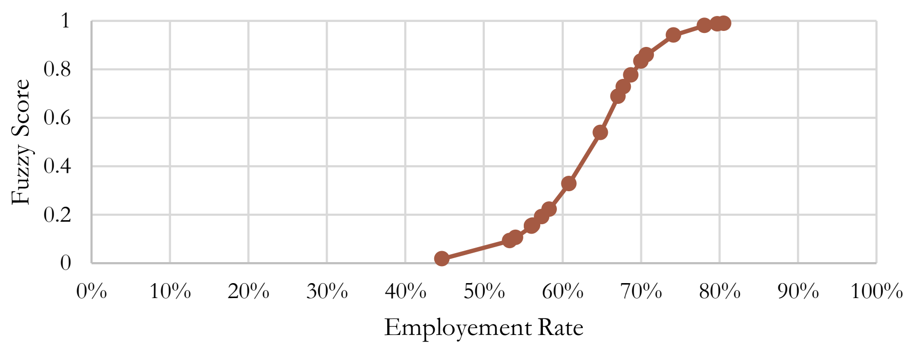


Figure E-8: Calibration for Employment

Data Source: survey question on total number of household members, number of members over 65 and under 18, and number employed.

Social

Social resilience is defined here as consisting of social capital, cohesion of communities (measured through birthplace), and the presence of community organizations and social mobilization. Each is equally important and is thus weighted evenly.

Social Capital

Literature has demonstrated the importance of social capital in connecting communities and increasing resilience to hazards (Aldrich 2012). I used the extent of shared resources to demonstrate linking, bridging, and bonding capital in practice. In set is considered intensive forms of assistance, such as medical care. These often require linking capital to mobilize barangay leaders to assist in transportation to medical facilities or access to medicines. Further it demonstrates a high level of bonding capital where neighbors are invested in the well-being of their community. Out of set membership is considered to be information dissemination. This was found to be culturally embedded and may not apply to less collective cultures however. Sharing of cash to neighbors is used as the crossover point as it represents a liquid asset that can be used at the discretion of the household receiving assistance and shows a higher level of bonding and trust between neighboring households.

Table E-29: Calibration for Social Capital

Fuzzy-Set Score	Condition
0	Households inform their neighbors of meeting and opportunities.
0.33	Households provide food to those households in need. All previous aspects are also present.
0.67	Community members provide non-reimbursed cash to neighbors in need. All previous aspects are also present.
1	Households provide medical care to neighbors in addition to other time intensive activities such as child care. All previous aspects are also present.

Data Source: interviews and field notes (from surveys)

Native to Community

Place based location has shown to be important to social resilience as social ties are likely more developed and expansive. Further, new resident to a community are often located in vulnerable sites that have greater hazard exposure. I used a structured set of Philippine political divisions to distinguish birthplace. Those households born in another province are considered out of set, as there are often differences in language and cultural norms. In set membership was considered birth within the barangay.

Table E-30: Calibration for Native to Community

Fuzzy-Set Score	**Condition**
0	Household heads are born in ***other province*** than currently residing.
0.33	Household heads are born in ***province of current residence***.
0.67	Household heads are born in ***municipality of current residence***.
1	Household heads are born in ***barangay of current residence***.

Data Source: survey question on birthplace

Community Organizations and Mobilization

In addition to organic social ties, established community organizations can leverage resources to respond to community needs. Out of set membership is defined as low participation in barangay meetings and the absence of community organizations. In set is defined as formalized organizations with active participation from constituents. The crossover point is informal groups that have emerged, such as social groups surrounding livelihoods as these afford many of the same benefits as established organizations, but lack the same level of legitimacy and recognition from local governments.

Table E-31: Calibration for Community Organizations and Mobilization

Fuzzy-Set Score	**Condition**
0	Households do not participate in barangay meetings (if held) and there are not informal social groups within barangay.
0.33	Households actively attend barangay meetings on a regular basis.
0.67	Presence of informal groups, such as around livelihood activities or a homeowners association.
1	Formalized groups present, such as the Red Cross or local NGOs, with active participation with barangay households.

Data Source: survey question on organizations and participation

Sustainability

Overall sustainability is taken as the average of economic, social, and environmental dimensions. Each sub-condition is weighted evenly within each respective dimension.

Economic

Household Wealth

In contrast to savings which are used to measure the economic buffer a household possess, income represents the ability of a household to sustain and support itself. Both income and expenditure household data were collected, however expenditure data proved to be less susceptible to fluctuations. Employment for most households surveyed changed on a weekly basis and thus income changed dramatically from one week to the next. Expenditures were found to be much more consistent and 'smoothed' out fluctuations in household finances. Further, almost all money earned was observed to be spent by households on essential needs. Data for this condition are taken as the reported average weekly expenditures for households. Weekly averages are used in place of monthly or annual averages as it was easier for respondents to answer expenses on a weekly basis.

The minimum wage for Region VII, which all of the communities were located, was P235 per day for retail and service industries (the lowest of any sector) as of 2015 (Cayanong 2015). Other sector daily minimum wages were P260 for non-agriculture, P238 for handicraft, and P241 for agriculture (non-sugar) for reference. As of 2015 (the most recently reported data), the Philippine Statistics Authority reported that a family of five needed P6,329 per month, or P1,582 per week, to meet basic food needs (Perez 2016). Further, an income of P9,064 per month, or P2,266 per week, was needed to meet both food and non-food needs. Regionally, the annual per capita poverty threshold as of 2015 was P21,304, or P444 per capita per week (Perante 2016). The poverty threshold is based off meeting food and non-food needs.

All but one of the 19 communities studied fell below the regional poverty threshold. This threshold is considered fully in set as it represents a sustainable income level. Adjusting the national average for food needs, the per capita income required would be P316 per person per week. This value is used as out of set membership as it constitutes the most basic level of necessity required for an individual. Assuming minimum wage for the average family size of five, one full time working adult (5 days a week), and one half-time working adult (2.5 days per week – part time work is common for the female head of household), the household would net P352 per capita per week. This value is used as a crossover point as it represents the standard for most households yet falls below the poverty threshold.

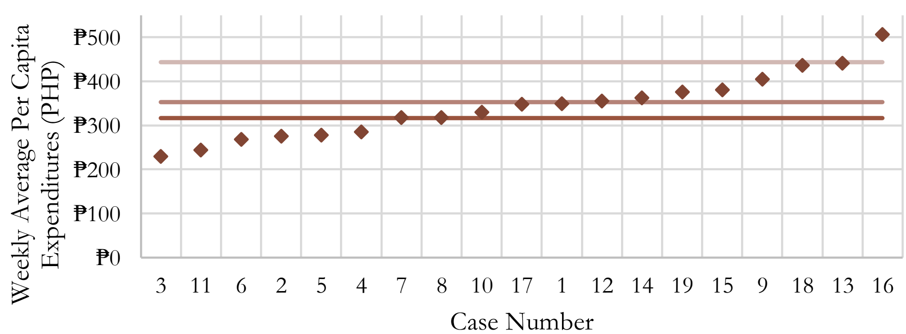


Figure E-9: Threshold and Crossover Points in Direct Calibration for Household Wealth

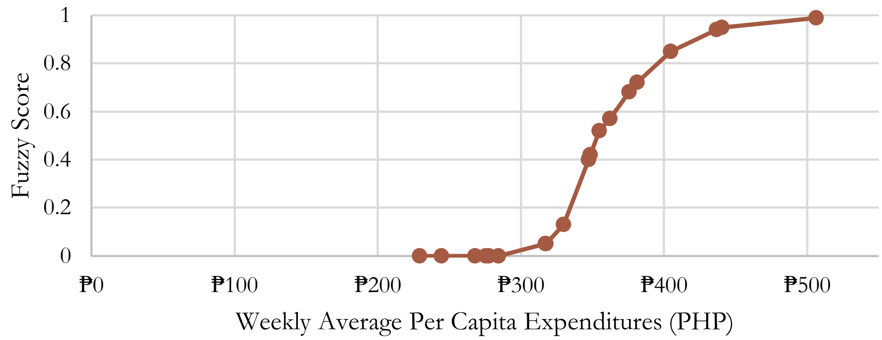


Figure E-10: Calibration for Household Wealth

Data Source: survey question to households on expenditures and household size

Notes: I initially used household expenditures, but this did not adequately take into consideration household size. For example, the community with the highest average expenditures (wealth), also had one of the largest average household sizes. A per capita wealth measure more realistically represents the ability of a household to sustain itself.

Service Interruptions

While access to water and electricity are considered as indicators of resilience (Cutter 2016), frequency of interruptions can be considered a metric of sustainable service provision. Regular interruptions signal that water and electrical systems are stressed on a regular basis and unable to meet the basic needs of households. Water and electricity have also been shown to increase economic production and livelihood opportunities.

Table E-32: Calibration for Service Interruptions

Fuzzy-Set Score	Condition
0	Service interruptions to water and/or electricity are ***once per day***.
0.33	Service interruptions to water and/or electricity are ***once per week.***
0.67	Service interruptions to water and/or electricity are ***once per month***.
1	Service interruptions to water and/or electricity are ***infrequently or never.***

Data Source: survey question asking about interruptions to drinking water, washing/bathing water, and electricity.

Notes: I initially had this condition listed in environmental sustainability but it fits better under economic due to the linkages to livelihoods.

Social

Land Ownership

The longevity of housing within a community is dependent upon sustainable land agreements. In particular, ownership, and to some degree formal rentals, is important to ensure that households are not evicted. Land disputes can be one cause of social disputes that arise within communities, particularly in urban areas (Zhu and Simarmata 2015). This divide between formal and informal land use is a driver of social inequality and distances of power dynamics within communities. In the Philippines there is a long history of land control reinforcing social inequalities – an issue which to date remains despite numerous attempts at land reform (El-Ghonemy 2006).

Out of set membership is defined as informal settlement with no permission granted by the land owner. In set membership is defined as ownership, with distinction between the household having the land title and not. Rental agreements are considered to be slight out of set. It is common in the Philippines that land rental is considered separate from ownership of the physical housing unit. As a result, should a household be forced to move from rented land, the cost of moving the housing materials to a new site may be cost prohibitive and result in loss of significant capital.

Table E-33: Calibration for Land Ownership

Fuzzy-Set Score	Condition
0	Informal settlement
0.2	Rent (free)
0.6	Rent (paid)
0.8	Own (w/o land title)
1	Own (w/ land title)

Data Source: survey question on land tenure – categorical data (own (with land title), own (w/o land title), rent (paid), rent (free), informal settlement)

Shelter Satisfaction

Despite improvements and lessons learned, shelter programs continue to neglect cultural suitability and homeowner needs. As a result, shelters are often abandoned, modified, or not maintained (Félix et al. 2013). Past studies have used satisfaction of shelter as a measure of its perceived habitability (Rand et al. 2011). As a result, I draw from survey data that asked homeowners to compare their existing house to their house before Haiyan. Household responses for each community were averaged using a 5-point weight scaled for the five categorical responses (much worse [-1], somewhat worse [-0.5], about the same [0], somewhat better [0.5], much better [1]). Ideally, shelter programs would improve living conditions, thus a response of "somewhat better" is considered to be fully in set. "About the same" is considered to be fully out of set. Despite pre-existing conditions being restored, these were often inadequate before the typhoon. An average score between the same conditions and somewhat better (a score of 0.25) is used as the crossover point as it suggests ambiguity in whether there was an improvement.

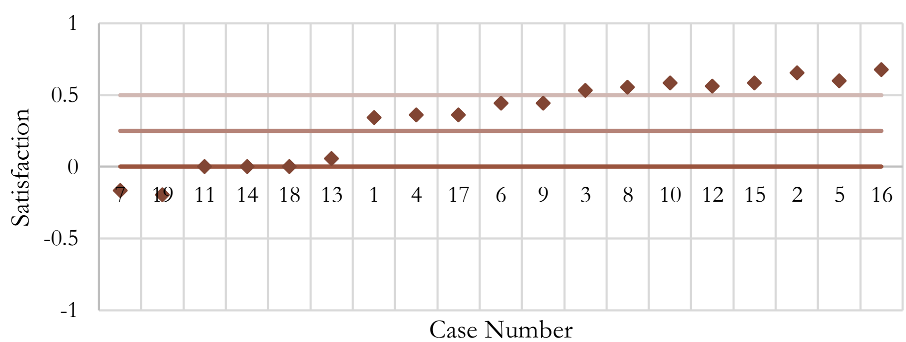


Figure E-11: Threshold and Crossover Points in Direct Calibration for Satisfaction with Shelter

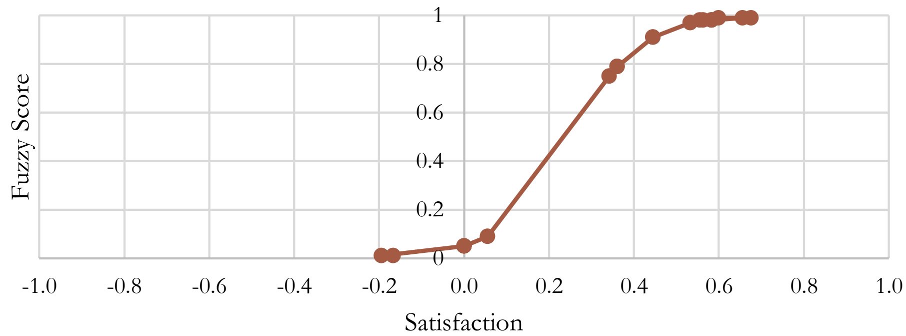


Figure E-12: Calibration for Satisfaction with Shelter

Data Source: survey question on comparing current house to home pre-Haiyan (much worse, somewhat worse, about the same, somewhat better, much better)

Notes: Generally, satisfaction was high for programs with only two programs falling below pre-existing housing before the typhoon. An alternative calibration might have been indirect (instead of direct).

Environmental

Sanitation System

While institutional environmental protections are an important part of sustainability, at the community level, household sanitation (or the lack thereof) is often the largest contributor to pollution. As such, the presence of sanitation facilities plays a significant role in improving public health, which in turn impacts quality of life. Three primary types of treatment systems were observed in the studied communities. These include unlined pit latrines, lined pit latrines, and septic tanks. Line pits typically used concrete masonry units (locally referred to as 'hollow blocks'). The distinction between lined pits and septic tanks is whether or not the system has a closed bottom. The absence of any sanitation system, or widespread use of open defecation, is considered to be out of set. The use of septic tanks is the primary treatment system is considered in set while lined pits are slightly in set and unlined are slightly out of set.

Table E-34: Calibration for Sanitation System

Fuzzy-Set Score	Condition
0	None (ocean or water source)
0.33	Unlined Pit Latrine
0.67	Lined Pit Latrine
1	Septic Tank

Data Source: survey question on sanitation system (septic tank, lined pit latrine, unlined pit latrine, or none)

Building Material Sourcing

One of the most widely cited measures of infrastructure sustainability concerns the sourcing of building materials (Ugwu and Haupt 2007). Efforts to define sustainability commonly focus on the necessity for materials to be locally available. While materials such as concrete are known to have higher initial carbon footprints than other materials such as timber, there is still ongoing debate about which of these materials is more sustainable when considered in life cycle analysis (LCA). Beyond the obvious reduction in transportation emissions from sourcing materials locally, there are a host of other benefits derived including supporting local economies and a construction workforce knowledge in building types.

Out of set is considered to be the inability to obtain a significant portion of the building materials and components (e.g. strapping) locally. In set is defined as all of the building materials and components can be found locally. The primary distinction between in set and out of set membership is whether or not all of the primary building materials (frame, wall, and roofing) are available in local markets. The availability of materials is based off market observations 30 months' post-disaster.

Table E-35: Calibration for Building Material Sourcing

Fuzzy-Set Score	Condition
0	Building material and components are ***not*** available locally.
0.33	Some, but not all, building materials are available locally
0.67	All of the building materials are available locally, however certain components such as strapping not.
1	All building materials and components are available locally.

Data Source: homeowner interviews and market observations

Other Outcomes

Shelter Adaptations

For households recovering from disaster, shelter is a process that does not end after external assistance departs. In many cases, the assistance provided to beneficiaries is intended to provide the basics that allow for families to begin the process of re-establishing their lives. A key indicator that households are recovering is self-initiated expansions or modifications to shelter. The earliest completion date of any of the shelter programs studied was in November 2014, one year after Haiyan. All but 2 or the 19 observed programs were completed by June 2015, approximate a year and half after the typhoon. Using observations from 30 months' post-disaster in March 2016, the number of adaptations to shelters for each program were observed. These were categorized into three groups based on observations for calibration. Households that had made no additions or improvements since handover are considered out of set. In set membership is considered to be major improvements to shelters, such as adding new rooms, kitchens, living spaces, bedrooms, porches, toilets (if not provided), or storage areas. Minor improvements, such as interior partitions, waterproofing, or interior design upgrades which didn't expand the actual livable space are considered to be slightly in set and assigned a fuzzy score of 0.7.

Table E-36: Calibration for Shelter Adaptations

Fuzzy-Set Score	Condition
0	None – household has not made any additions or improvements to the shelter since handover.
0.7	Minor – added additional interior partitions, tarps for waterproofing walls/ceilings, tile flooring, windows, or other features which upgrade shelter, but don't extend floor area.
1	Major – added new rooms, such as a kitchen, living space, bedrooms(s), porch, toilet, or storage area

Data Source: survey question on adaptations to shelter and observations

Notes: I used 50% of households as cutoff for out of set and 80%+ of households as fully in set.

Construction Knowledge

Construction knowledge was defined based on the 8 Key Messages produced by the Shelter Cluster, as these were widely distributed among households. A 15 question survey (see Appendix C) was used to assess and average construction knowledge in each community. Based on analysis conducted in Chapter 4, anchor points were set as an average score of 11, while out of set was set at 10. The crossover point was set evenly between the anchor points. While there is a small quantitative difference between the average test scores, ANOVA analysis demonstrates statically significant difference between cases with averages scores over 11 and under 10. Further, drawing from case knowledge, there were noticeable difference in understanding of construction concepts between communities with these average scores.

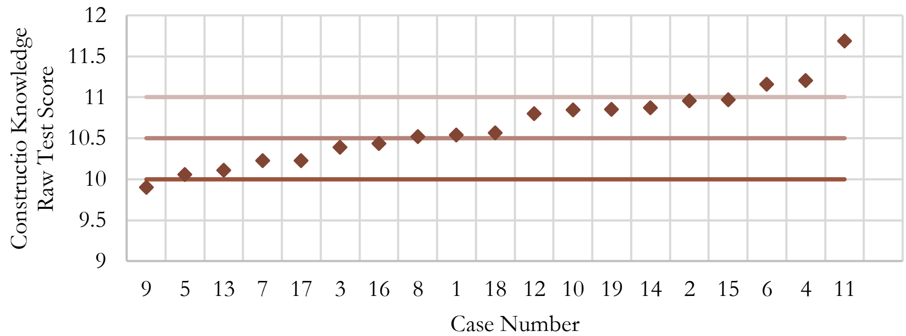


Figure E-13: Threshold and Crossover Points in Direct Calibration for Construction Knowledge

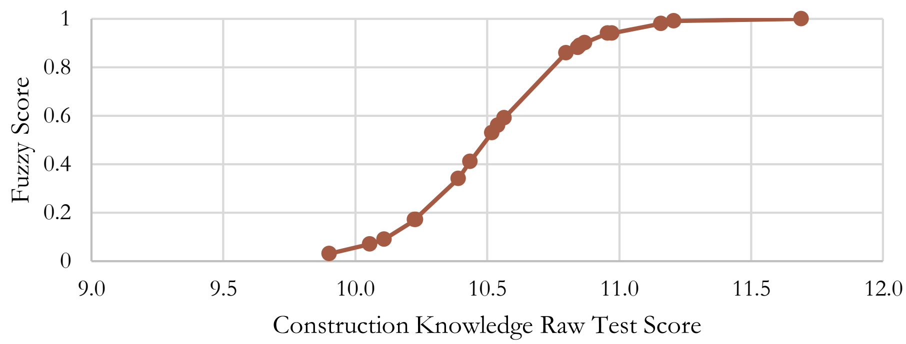


Figure E-14: Calibration for Construction Knowledge

Aggregating Conditions into Project Phases

Table E-37 provides a summary of all conditions used for analysis in Chapter 5. The conditions for training method learning poles and value of aid are excluded, as these were not aggregated into the project phase conditions (e.g. planning coordination, design participation). Table E-38 provides a summary of the sub-outcomes aggregated into resilience dimensions and Table E-39 summarizes sub-outcomes aggregated into sustainability dimensions.

Table E-37: Summary of Condition Calibrations

Phase	Category	Component	Score	Description
Planning	**Coordination**: Average of shelter sector involvement, cross-sector integration, and land rights	*Shelter Sector Involvement*	0	Shelter organization was aware of cluster coordination, but did not attend meetings or report activities.
			0.33	Shelter organization was aware of cluster coordination and attended sporadically, but did not send a consistent person to meetings and did not report activities.
			0.67	Shelter organization attended shelter cluster meetings but did not send a consistent person. The organization did report on activities to the cluster.
			1	Shelter agency actively attended cluster meetings by sending a consistent person and reported activities to the cluster.
		Cross-Sector Integration		Sum of scores for each sector included in shelter programming.
			0.33	Livelihood
			0.33	WASH
			0.33	Disaster Risk Reduction
		Land Rights	0	Land tenure was not secured for the duration of the shelter assistance provided.
			0.7	Tenure secured, but no documentation provided to beneficiary.
			1	Land tenure was secured in advance of construction.
	Stakeholder Participation: Average of location selection and determination of aid	*Location Selection*	0	Households had no say in location of shelter – government or NGO determined relocation.
			1	Households made decision of location of shelter.
		Determination of Aid	0	Donor funding or organization pre-determined type of aid and requirements. Households were not involved in assessing needs.
			0.7	Implementing organization determined type of aid based on second-hand assessment (NGO or government conducted) without consultation with households.
			1	Implementing organization determined type of aid based on first-hand assessment (NGO or government conducted) with consultation with households.
Design	**Coordination**: Average of provision of WASH and uniform design standards	*Provision of WASH*	0	Water supply and sanitation facilities were not included in housing design.
			0.33	Water supply OR sanitation facilities were provided in housing design.
			0.67	Design included access to water supply AND shared sanitation facilities.
			1	Design included access to water supply AND private sanitation facilities.
		Uniform Design Standards	0	Few, if any, Shelter Cluster messages were considered in the design of shelter.
			0.33	Minor adaptations were included in shelter design, but significant recommendations outlined in Shelter Cluster guidance were omitted.
			0.67	Major design elements recommended by the Shelter Cluster, such as bracing, were included in the design of shelter.
			1	Household or organization developed design in-line with all Shelter Cluster messaging.
	Stakeholder Participation: Average of floorplan and layout and government permitting	*Floorplan and Layout*	0	Households were never consulted on the floorplan and layout of the shelter.
			0.33	Households were consulted through a large community meeting to discuss housing features.
			0.67	Households were provided floor plan and asked preferences, such as location of doors and windows, that were then included in the final design.
			1	Households were asked to actively participate in the development of floorplans and had control over final design decisions.
		Government Permitting	0	Municipal government did not provide documented permission on design of shelter.
			1	Municipal government was consulted prior to construction, provided recommendations and written approval.

Table E-37: Summary of Condition Calibrations (cont.)

Construction	**Stakeholder Participation**			
	Average of sweat equity, material procurement, financial management, and oversight			
	Sweat Equity		*Material Procurement*	
	0	Household was not involved in construction labor.	0	Homeowner was not involved in the material procurement process.
	0.33	Household contributed minimal labor during construction. Tasks were confined to site works, not construction.	1	Homeowner was required to receive, inspect, and certify materials from organization, provide protection during construction, and organize transportation, if required.
	0.67	Homeowner contributed minimal labor to construction. Tasks involved construction, not just site work.		
	1	Homeowner contributed significant labor to construction. Tasks may have involved a combination of construction and site work.		
	Financial Management		*Oversight*	
	0	Beneficiary was not responsible for any aspect of managing shelter construction finances.	0	No inspection of construction.
	0.7	Beneficiary was responsible for managing labor expenses for shelter construction or a component of material expenses.	0.3	Organization and household members inspected shelter at sporadic milestones, however no action was observed on items requiring rework or modification.
	1	Beneficiary had significant role in managing shelter budget including labor and materials.	1	Organization and household members inspected shelter at major milestones. Action was observed on items that required rework or modification.
	Training			
	Minimum of observations and diversity of methods			
	Observations		*Diversity of Methods*	
	0	Household was NOT present during shelter construction.	0	No training was provided to homeowners.
	1	Household was present during shelter construction.	0.33	Training methods used 2 of the 4 experiential learning theory poles.
			0.67	Training methods used 3 of the 4 experiential learning theory poles.
			1	Training methods were used that covered all four poles of the Kolb Learning Style Inventory

Table E-38: Resilience Calibration

Infrastructure	Average of shelter, water access, sanitation access, power access, education access, medical care access, transportation, and evacuation centers					
	Shelter: minimum of shelter design and shelter construction quality					
	Shelter Design		*Shelter Construction Quality*		*Water Access*	
	Directly calibrated based on average number of Shelter Cluster "8 Key Messages" observed.		0	Structures lack concrete foundations and use light materials for walls and roofing. Limited to no connections are used between members.	0	Water source is over 10 minutes walking distance and quantity provided is less than 15 liters/person/day.
	0.05	Average of 3 "Key Messages" present in design	0.33	Structures lack concrete foundations and use light materials for walls and roofing. Connections, such as steel straps or cleats, are used.	0.33	Water source is under 10 minutes walking distance but quantity provided is less than 15 liters/person/day.
	0.5	Average of 5 "Key Messages" present in design	0.67	Structures have concrete foundations. Plywood or hardiflex walling is provided, although lateral bracing is absent. Connections, such as steel straps or cleats, are used.	0.67	Water source is over 10 minutes walking distance but quantity provided is 15 liters/person/day or more.
	1	Average of 7 "Key Messages" present in design	1	Structures have concrete foundations. Plywood or hardiflex walling is provided with lateral bracing. Masonry construction may also be used in place of timber construction. Connections, such as steel straps or cleats, are used for roof members.	1	Water source is within 10 minutes walking distance and quantity provided is 15 liters/person/day or more.
	Sanitation Access		*Electrical Access*		*Education Access*	
	0	Open defecation is predominant sanitation practice	0	Households have no access to electrical connection	0	Nearest primary and high school is more than 30 minutes
	0.3	More than 25% of households share communal or neighbor's toilets	0.7	Households predominantly share a power connection with a neighbor or collective of neighbors.	0.33	Nearest primary and high school is between 15 minutes to 30 minutes.
	1	Households have private access to a toilet	1	Households have private electrical connections	0.67	Nearest primary and high school is between 5 minutes and 15 minutes.
					1	Nearest primary and high school is less than 5 minutes.
	Medical Care Access		*Transportation*		*Evacuation Centers*	
	0	Nearest hospital is more than 1 hour.	0	Barangay roads are of poor quality and are either dirt or show significant signs of cracking.	0	Distance to nearest safe evacuation site is more than 500m.
	0.33	Nearest hospital is between 30 minutes to 1 hour.	0.33	Barangay roads are of below average quality and are a mix of dirt and/or paved, with minor signs of cracking or rutting.	1	Distance to nearest safe evacuation site is less than 500m.
	0.67	Nearest hospital is between 15 minutes and 30 minutes.	0.67	Barangay roads are of above average quality and are a mix of dirt and/or paved, with no signs of cracking or rutting.		
	1	Nearest hospital is less than 15 minutes.	1	Barangay roads are of excellent quality and are all paved with minimal sizes of cracking or rutting.		

Table E-38: Resilience Calibration (cont.)

Governance	Average of disaster management planning and regional cooperation					
	Disaster Management Planning		*Regional Cooperation*			
	0	Barangay has not held any evacuation drills in the last year.	0	Low cooperation between neighboring barangays and municipality and the barangay has NOT shared its disaster management plan with neighboring barangays and its municipality.		
	0.7	Barangay has held evacuation drill in the last year with assistance from municipal government or non-governmental organization.	0.33	Low cooperation between neighboring barangays and municipality but the barangay has shared its disaster management plan with neighboring barangays and its municipality.		
	1	Barangay has initiated its own evacuation drill in the last year without assistance from external organization.	0.67	Strong cooperation between neighboring barangays and municipality but the barangay's disaster management plans have NOT been shared with neighboring barangays and its municipality.		
			1	Strong cooperation between neighboring barangays and municipality and barangay has shared its disaster management plan with neighboring barangays and municipality.		
Economic	Average of household savings and employment					
	Household Savings		*Employment*			
	Directly calibrated based on average housing savings		Directly calibrated based labor force participation rate.			
	0.05	P0	0.05	50% labor participation		
	0.5	P317 (1 day of savings at poverty threshold)	0.5	64.3% labor participation (2016 average for Region VIII in Philippines)		
	0.95	P1,582 (5 days of savings at poverty threshold)	0.95	75% labor participation		
Social	Average of social capital, native to community, and community organizations and mobilization					
	Social Capital		*Native to Community*		*Community Organizations and Mobilization*	
	0	Households inform their neighbors of meeting and opportunities.	0	Household heads are born in other province than currently residing.	0	Households do not participate in barangay meetings (if held) and there are not informal social groups within barangay.
	0.33	Households provide food to those households in need. All previous aspects are also present.	0.33	Household heads are born in province of current residence.	0.33	Households actively attend barangay meetings on a regular basis.
	0.67	Community members provide non-reimbursed cash to neighbors in need. All previous aspects are also present.	0.67	Household heads are born in municipality of current residence.	0.67	Presence of informal groups, such as around livelihood activities or a homeowners association.
	1	Households provide medical care to neighbors in addition to other time intensive activities such as child care. All previous aspects are also present.	1	Household heads are born in barangay of current residence.	1	Formalized groups present, such as the Red Cross or local NGOs, with active participation with barangay households.

Table E-39: Sustainability Calibration

Economic	Average of household wealth and service interruptions			
	Household Wealth		*Service Interruptions*	
	Directly calibrated based on per capita household weekly income		0	Service interruptions to water and/or electricity are once per day.
	0.05	P316 per capita per week	0.33	Service interruptions to water and/or electricity are once per week.
	0.5	P353 per capita per week	0.67	Service interruptions to water and/or electricity are once per month.
	0.95	P444 per capita per week	1	Service interruptions to water and/or electricity are infrequently or never.
Social	Average of land tenure and shelter satisfaction			
	Land Tenure		*Shelter Satisfaction*	
	0	Informal settlement	0.05	0 weighted satisfaction average ("about the same as pre-disaster shelter")
	0.2	Rent (free)	0.5	0.25 weighted satisfaction average
	0.6	Rent (paid)	0.95	0.5 weighted satisfaction average ("somewhat better than pre-disaster shelter")
	0.8	Own (w/o land title)		
	1	Own (w/ land title)		
Environmental	Average of sanitation system and building material sourcing			
	Sanitation System		*Building Material Sourcing*	
	0	Open defecation	0	Building material and components are not available locally.
	0.33	Unlined pit latrine	0.33	Some, but not all, building materials are available locally.
	0.67	Lined pit latrine	0.67	All of the building materials are available locally, except for specialty items.
	1	Septic tank	1	All building materials and components are available locally.

APPENDIX F QUALITATIVE COMPARATIVE ANALYSIS ANALYTICAL PROCEDURES

In this section, a summary of analytical procedures for QCA is provided, including a discussion of simplifying assumptions, individual condition necessity and sufficiency scores in relation to each outcome, pathways, and any subset/superset analysis that was completed. For all analysis, intermediate solutions were used. Solutions to the negated outcomes are also provided for validation purposes.

The first section presents analysis conducted for Chapter 3 investigating combinations of participation that led to the outcomes of households satisfaction, safe shelter design, shelter adaptations, household savings, and social capital. Analysis for Chapter 4 exploring pathways of training conditions that led to construction knowledge acquisition can be found starting on page 319. Analysis for Chapter 5 investigating pathways to resilience and sustainability outcomes can be found starting on page 323.

Participation Analysis

The truth table for the participation analysis is provided below, the outcomes in Table F-1 and conditions in Table F-2. A summary of the condition and outcome calibrations can be found in Appendix E. The pathways for the first two outcomes, household satisfaction with shelter and sound technical design of shelter, are discussed in Chapter 3. Three additional outcomes – shelter adaptations, household savings, and community social capital – are also included in this appendix.

For the outcomes considered, nine conditions were included in initial analysis. A consistency cutoff of 0.8 was used, while also considering proportional reduction in inconsistency (PRI) of pathways. While no specific cutoff was used for PRI, pathways with large gaps between raw consistency and PRI values were removed. Through subset/superset analysis conditions were then removed in order to achieve more parsimonious solutions.

Table F-1: Participation Truth Table Outcomes

Case	Community	*Satisfact*	*Design*	*Adapt*	*Savings*	*SocCap*
1	Okoy	0.75	0.46	1	0.15	0.67
2	Maricaban	0.99	0.92	0	0.23	0
3	Poblacion	0.97	0.75	1	0.15	0.67
4	Sungko	0.79	0.05	1	0.24	0.33
5	Sillon	0.99	0.45	0.7	0.51	0.33
6	Kangkaibe	0.91	0.75	0.7	0.05	0.33
7	Tagpuro	0.01	0.72	0	0.53	0.33
8	Pago	0.98	0.71	1	0.14	0.33
9	New Kawayan (101)	0.91	0.10	1	0.99	1
10	Bagacay (93)	0.98	0.53	0.7	0.19	0.33
11	San Agustin	0.05	0.16	0.7	0.35	1
12	San Jose (83C)	0.98	0.88	0.7	0.63	0.67
13	Magallanes (52)	0.09	0.39	0	0.77	0
14	San Jose (85)	0.05	0.16	0	0.05	0.33
15	Hiabangan	0.98	0.24	0	0.87	1
16	Sagkahan (62)	0.99	0.82	0	0.94	0.67
17	Sulangan	0.79	0.95	1	0.79	0.67
18	Cogon	0.05	0.76	0.7	0.3	0.67
19	Cantahay	0.01	0.59	0.7	0.21	0.33

Table F-2: Participation Truth Table Conditions

Case	Community	*Value*	*Location*	*DeterAid*	*Floorplan*	*GovPermit*	*SweatEquity*	*Procurement*	*FinManage*	*Oversight*
1	Okoy	0.65	1	0.7	0.33	1	0.33	0	0	0.3
2	Maricaban	0.97	0	0.7	0	1	1	0	0	1
3	Poblacion	0.88	0	1	0	1	1	0	0	1
4	Sungko	0.04	1	1	1	0	0.33	0	0.7	0
5	Sillon	0.63	0	1	0	1	0	0	0	1
6	Kangkaibe	0.49	1	0	0	1	0	1	0	1
7	Tagpuro	0.39	0	0.7	0	1	0	0	0	1
8	Pago	0.97	0	0.7	0	1	1	0	0	0.3
9	New Kawayan (101)	0.03	1	1	1	0	0	0	0.7	1
10	Bagacay (93)	0.74	1	0	0	1	0.33	0	0	0.3
11	San Agustin	0.61	1	0	0	0	0.67	0	0	0
12	San Jose (83C)	0.61	1	1	0.67	1	0	0	0	1
13	Magallanes (52)	0.20	1	1	0.67	1	0.33	1	1	1
14	San Jose (85)	0.03	1	1	1	0	0.33	1	1	0.3
15	Hiabangan	0.04	1	1	1	0	0.33	0	1	0
16	Sagkahan (62)	0.77	1	1	0.67	1	0	1	0	1
17	Sulangan	0.85	1	0.7	0.67	1	0.33	1	1	1
18	Cogon	0.41	0	0.7	0	1	0	0	0	1
19	Cantahay	0.33	1	0	0.33	1	0.33	1	0.7	1

Simplifying Assumptions

Part of QCA relies on Boolean minimization, drawing from relevant theoretical and substantive knowledge in order to resolve counterfactuals. In order to achieve parsimony in the solutions created, I have drawn on 'easy counterfactuals' to reduce complexity (Ragin and Sonnett 2005). While often neglected, simplifying assumptions constitute an important step in the QCA process. For each outcome, I have included a discussion of assumptions made, drawing on theoretical and case knowledge used to inform these decisions. A summary of simplifying assumptions for all conditions are presented in Table F-3 below.

Table F-3: Summary of Simplifying Assumptions for Participation

	Satisfaction	Design	Adaptations	Savings	Social Capital
Value of Aid	Present	Present	Present or Absent	Present	Present
Location Selection	Present	Present	Present	Present	Present
Determination of Aid	Present	Present	Absent	Present	Present
Floorplan and Layout	Present	Present or Absent	Absent	Present	Present
Government Permitting	Present	Present	Present	Present	Present
Sweat Equity	Present	Absent	Present	Present or Absent	Present
Procurement	Present	Present	Present or Absent	Present	Present
Financial Management	Present	Present or Absent	Present or Absent	Present	Present or Absent
Oversight	Present	Present	Present or Absent	Present	Present

Satisfaction

As a preliminary step, I first investigate the necessity and coverage of individual conditions on household satisfaction of shelter. The results of this initial analysis are shown in Table F-4 below. The presence of all conditions is expected to lead to household satisfaction with shelter.

We would expect higher monetary value of assistance, choice in selecting site location, and greater involvement in determining type of aid to be linked to satisfaction as these early decisions bring in more resources, situate assistance on desired sites, and provide for equitable distribution. Floorplan and layout choices and government permitting adapt shelter to need individual households needs and secure tenure. Procurement and oversight both allow for greater household control and verification of quality during construction. Further, financial management by households allows for higher control over where resources are directed which is expected to lead to higher satisfaction. All of these were considered 'easy counterfactuals' that draw from past theory. Sweat equity was the only condition that might be considered a 'difficult counterfactual.' Simplifying assumptions were initially omitted for this condition, however case knowledge showed that in almost all cases, sweat equity was positively associated with a sense of pride of accomplishments and satisfaction with the final shelter product. Notably, this was not always the case *during* construction when sweat equity requirements were being fulfilled, but was universally linked after completion, thus the reason I assume that its presence, rather than absence, is linked to satisfaction.

Table F-4: Necessity and Sufficiency of Household Satisfaction Outcome

Condition	**Necessity**	**Coverage**
Determination of Aid	0.783211	0.72803
Government Permitting	0.773431	0.677857
Oversight	0.704156	0.654545
Location Selection	0.674817	0.636923
Value of Aid	0.639296	0.814004
Floorplan and Layout	0.421353	0.70436
Sweat Equity	0.390383	0.759113
Financial Management	0.270579	0.544262
Procurement	0.231459	0.473333

Assumptions:

- Oversight (present)
- Financial Management (present)
- Procurement (present)
- Sweat Equity (present)
- Government permitting (present)
- Floorplan and Layout (present)
- Determination of Aid (present)
- Location Selection (present)
- Value (present)

Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
govpermit*location*value	0.338513	0.277388	0.893252	Sulangan, Sagkahan (62), Bagacay (93), Okoy, San Jose (83C)
sweatequity*govpermit*deteraid*value	0.247094	0.185969	0.964906	Poblacion, Pago, Maricaban
finmanage*~procurement*~sweatequity* floorplan*deteraid*location	0.16625	0.166259	1.000000	New Kawayan, Sungko, Hiabangan

solution coverage: 0.690741

solution consistency: 0.944674

Subset/Superset Analysis

In order to potentially reduce the complexity of the solution obtained, I next investigate each of the pathways obtained in the initial intermediate solution to determine if there are simpler pathways which maintain the same level of consistency, but potentially greater coverage. The three pathways from the satisfaction solution are listed below. Combinations of conditions are listed for all subsets higher than the original pathway, if such subsets exist. If such a subset does not exist, then up to five subsets greater than the consistency cutoff value of 0.8, are listed.

Pathway 1: govpermit*location*value

Subset	Consistency	Coverage
value	0.814004	0.639296
govpermit*value	0.861564	0.624749
govpermit*location*value	0.893252	0.338513
location*value	0.80386	0.35306

Pathway 2: sweatequity*govpermit*deteraid*value

Subset	Consistency	Coverage
deteraid*value	0.875132	0.483004
sweatequity*govpermit*value	0.900873	0.318688
sweatequity*deteraid*value	0.965995	0.255292
sweatequity*govpermit*deteraid	0.920354	0.254279
sweatequity*govpermit*deteraid*value	0.964906	0.247094

Pathway 3: finmanage*~procurement*~sweatequity*floorplan*deteraid*location

Subset	Consistency	Coverage
finmanage*~procurement*~sweatequity	1	0.166259
finmanage*~procurement*~sweatequity*location	1	0.166259
finmanage*~procurement*~sweatequity*deteraid	1	0.166259

finmanage*~procurement*~sweatequity*floorplan	1	0.166259
finmanage*~procurement*~sweatequity*deteraid*location	1	0.166259
finmanage*~procurement*~sweatequity*floorplan*location	1	0.166259
finmanage*~procurement*~sweatequity*floorplan*deteraid	1	0.166259
finmanage*~procurement*~sweatequity*floorplan*deteraid*location	1	0.166259

My analysis of subsets shows that two conditions, oversight and floorplan and layout, may be removed as they do not appear in subsets that reduce the number of conditions while maintaining consistency. Oversight does not appear in any of the pathways and floorplan and layout selection does not appear in subsets of the third pathway. Case knowledge also supports that floorplan and layout plays a lesser role for cases involving the third pathway as the projects encompasses are all repair and retrofit programs. While these allowed for selection where materials were used, these decisions were not a central cause of household satisfaction. As such, the revised solution is presented below:

Revised Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
govpermit*location*value	0.338513	0.277388	0.893252	Sulangan, Sagkahan (62), Bagacy (93), Okoy, San Jose (83C)
sweatequity*govpermit*deteraid*value	0.247094	0.185969	0.964906	Poblacion, Pago, Maricaban
finmanage*~procurement*~sweatequity* deteraid*location	0.166259	0.166259	1.000000	New Kawayan, Sungko, Hiabangan

solution coverage: 0.690741

solution consistency: 0.944674

From the final solution, five cases fall into the first pathway, three into the second pathway, and three into the third pathway. I next perform similar analysis on the negated outcome, projects that did not achieve high satisfaction, to validate findings.

Absence of Satisfaction

A key distinction between QCA and other statistical methods that rely on correlational measures, a set theoretic approach draws from the notion of asymmetrical causality (Lieberson 1985 pp. 63–64). As such, explaining the presence of an outcome may differ from the explanation of the negated outcome. Similar to the previous outcome, I begin by investigating the necessity and sufficiency of individual conditions on the negated outcome. Corresponding to my previous discussion of simplifying assumptions, it is reasonable to assume that the inverse is true, thus I will assume that the absence of each condition leads to the negated outcome. While none of the conditions are necessary, sweat equity and value of aid appear as important (absent) conditions that lead to the absence of satisfaction. Sweat equity, the condition with the highest necessity, appeared both present and absence in leading to satisfaction. Given its relatively low necessity when compared to satisfaction and high necessity when compared to the absence of satisfaction, this suggests that in select cases it can be effective in instilling ownership, but more broadly does not lead to household satisfaction. The second condition to appear, value of aid, validates its appearance in earlier pathways to satisfaction. Surprisingly, floorplan and layout selection did not appear in the earlier pathways to satisfaction, but it had the third highest necessity when considered the negated outcome. In practice, input in housing design may not be necessary to achieve satisfaction, but it is a core component of dis-satisfaction.

Table F-5: Necessity and Sufficiency of Absence of Household Satisfaction Outcome

Condition	Necessity	Coverage
~Sweat Equity	0.774146	0.410559
~Value of Aid	0.733676	0.527330
~Floorplan and Layout	0.677563	0.391081
~Financial Management	0.586924	0.306202
~Procurement	0.530461	0.274615
~Determination of Aid	0.466568	0.541379
~Government Permitting	0.329866	0.444000
~Oversight	0.322437	0.374138
~Location Selection	0.298663	0.335000

Assumptions:

- Oversight (absent)
- Financial Management (absent)
- Procurement (absent)
- Sweat Equity (absent)
- Government permitting (absent)
- Floorplan and Layout absent)
- Determination of Aid (absent)
- Location Selection (absent)
- Value (absent)

Intermediate Solution

Pathway	**Raw Coverage**	**Unique Coverage**	**Consistency**	**Cases**
finmanage*procurement*~sweatequity*~value	0.320951	0.320951	1.000000	Cantahay, San Jose (85), Magallanes (52)
~oversight*~finmanage*~procurement* ~govpermit*~floorplan*~deteraid	0.141159	0.141159	0.950000	San Agustin

solution coverage: 0.461203

solution consistency: 0.984147

Subset/Superset Analysis

In order to examine ways to reduce the complexity of the above pathways, I examine subsets of the outcomes, in this case, the absence of satisfaction. A list of subsets for the 2 pathways are shown below. Combinations of conditions are listed for all subsets higher than the original pathway, if such subsets exist. If such a subset does not exist, then up to 5 subsets greater than the consistency cutoff value of 0.8, are listed.

Pathway 1: finmanage*procurement*~sweatequity*~value

Subset	**Consistency**	**Coverage**
procurement*~value	0.800517	0.395784
finmanage*procurement*~value	0.990954	0.380926
finmanage*procurement*~sweatequity	0.828358	0.329866
finmanage*procurement*~sweatequity*~value	1	0.320044

Pathway 2: ~oversight*~finmanage*~procurement*~govpermit*~floorplan*~deteraid

Subset	**Consistency**	**Coverage**
~govpermit*~deteraid	0.95	0.141159
~govpermit*~floorplan	0.95	0.141159
~govpermit*~floorplan*~deteraid	0.95	0.141159

~oversight*~govpermit*~deteraid	0.95	0.141159
~finmanage*~govpermit*~deteraid	0.95	0.141159
~finmanage*~govpermit*~floorplan	0.95	0.141159
~oversight*~govpermit*~floorplan	0.95	0.141159
~procurement*~govpermit*~deteraid	0.95	0.141159
~procurement*~govpermit*~floorplan	0.95	0.141159
~oversight*~govpermit*~floorplan*~deteraid	0.95	0.141159
~oversight*~finmanage*~govpermit*~deteraid	0.95	0.141159
~finmanage*~govpermit*~floorplan*~deteraid	0.95	0.141159
~oversight*~finmanage*~govpermit*~floorplan	0.95	0.141159
~oversight*~procurement*~govpermit*~deteraid	0.95	0.141159
~procurement*~govpermit*~floorplan*~deteraid	0.95	0.141159
~finmanage*~procurement*~govpermit*~deteraid	0.95	0.141159
~oversight*~procurement*~govpermit*~floorplan	0.95	0.141159
~finmanage*~procurement*~govpermit*~floorplan	0.95	0.141159
~oversight*~finmanage*~govpermit*~floorplan*~deteraid	0.95	0.141159
~oversight*~procurement*~govpermit*~floorplan*~deteraid	0.95	0.141159
~oversight*~finmanage*~procurement*~govpermit*~deteraid	0.95	0.141159
~finmanage*~procurement*~govpermit*~floorplan*~deteraid	0.95	0.141159
~oversight*~finmanage*~procurement*~govpermit*~floorplan	0.95	0.141159
~oversight*~finmanage*~procurement*~govpermit*~floorplan*~deteraid	0.95	0.141159

From the subset/superset analysis I can see that the removal of sweat equity has little impact on the first pathway and is absent entirely from the second pathway, thus I remove this condition. Further, oversight can be removed with an impact on the consistency or coverage in the second pathway. Location is absent from both pathways and subsets so it is also removed.

Revised Intermediate Solution

Pathway	**Raw Coverage**	**Unique Coverage**	**Consistency**	**Cases**
finmanage*procurement*~value	0.380926	0.380926	0.990954	Cantahay, San Jose (85), Magallanes (52)
~finmanage*~procurement*~govpermit* ~floorplan*~deteraid	0.141159	0.141159	0.950000	San Agustin

solution coverage: 0.522085

solution consistency: 0.979537

Through subset/superset analysis, the coverage was increase slightly with a negligible decrease in the solution consistency. Notably, I see that there are differences between programs that emphasized household financial management and procurement.

Safe Shelter Design

Similar to previous steps, I first test the necessity and sufficiency of individual conditions on the desired outcome – safe shelter design. This outcome is based on observations of design elements promoted in the Shelter Cluster '8 Key Messages' that were incorporated in shelter construction. The results of this initial analysis are shown in Table F-6 below. For two conditions, financial management and floorplan and layout, there is lacking theoretical basis to make a simplifying assumption.

For the remainder of the conditions, there is either theoretical or substantive knowledge to make an assumption of the directionality of relationship with the outcome of shelter design. For value of assistance, we would expect that with greater monetary value of assistance per households, designs will be improved. Similarly, for location selection, determination of aid, and government permitting, the choice and approval of where shelter is located should increase investment in stronger and more permanent structures. Allowing households to decide on floorplans and layouts may or may not translate to design improvement however, as such, I did not make an assumption for this condition. For sweat equity, there is reason to link its absence with improved design. In practice, requiring unskilled and unfamiliar households to perform labor is likely to lead to poor construction quality and implementation of intended designs. Sweat equity should not be confused with voluntarily household contributions, as households are often aware of their skill limitations and can hire needed labor in these cases. Procurement of materials and oversight should lead to improved design as households will be invested in ensuring that materials and construction are sufficient quality. No assumptions are made for financial management as it possible that households divert funds toward other needs, particularly in a resource constrained post-disaster context.

Table F-6: Necessity and Sufficiency of Shelter Design Outcome

Condition	Necessity	Coverage
Government Permitting	0.931708	0.690221
Oversight	0.879889	0.691337
~Financial Management	0.804836	0.647074
Value of Aid	0.78664	0.846627
~Floorplan and Layout	0.781436	0.695074
Determination of Aid	0.751037	0.590097
~Sweat Equity	0.743287	0.607478
Location Selection	0.584953	0.466674
Procurement	0.352445	0.609223
Floorplan and Layout	0.347799	0.491437
Financial Management	0.238837	0.406076

Assumptions:

- Oversight (present)
- Financial Management (present)
- Procurement (present)
- Sweat Equity (absent)
- Government permitting (present)
- Floorplan and Layout (present or absent)
- Determination of Aid (present)
- Location Selection (present)
- Value (present)

Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
oversight*~finmanage*~sweatequity*govpermit*~floorplan*deteraid	0.271097	0.058300	0.836801	Sillon, Tagpuro, Cogon
~finmanage*govpermit*~floorplan*deteraid*~location*value	0.327107	0.206872	0.914679	Poblacion, Pago, Maricaban, Sillon
oversight*procurement*~sweatequity*govpermit*~floorplan*location	0.224026	0.141080	0.873481	Kangkaibe, Cantahay
oversight*~finmanage*~sweatequity*govpermit*deteraid*location*value	0.162160	0.027059	1.000000	Sagkahan (62), San Jose (83C)
oversight*procurement*~sweatequity*govpermit*deteraid*location*value	0.158268	0.032783	1.000000	Sagkahan (62), Sulangan

solution coverage: 0.772558

solution consistency: 0.886958

Subset/Superset Analysis

For my initial analysis there are 5 pathways, each fairly complex. In order to create more parsimonious pathways, I look at subsets of the intermediate solution, aiming to increase coverage and determine extraneous conditions that could potentially be removed. Combinations of conditions are listed for all subsets higher than the original pathway, if such subsets exist. If such a subset does not exist, then up to 5 subsets greater than the consistency cutoff value of 0.8, are listed.

Pathway 1: oversight*~finmanage*~sweatequity*govpermit*~floorplan*deteraid

Subset	Consistency	Coverage
oversight*~floorplan*deteraid	0.866644	0.503039
~floorplan*deteraid	0.850523	0.556826
govpermit*~floorplan*deteraid	0.850523	0.556826
oversight*govpermit*~floorplan*deteraid	0.866644	0.503039
oversight*~finmanage*~floorplan*deteraid	0.850224	0.439402
oversight*~finmanage*govpermit*~floorplan*deteraid	0.850224	0.439402
oversight*~sweatequity*~floorplan*deteraid	0.863595	0.334734
oversight*~sweatequity*govpermit*~floorplan*deteraid	0.863595	0.334734
oversight*~finmanage*~sweatequity*~floorplan*deteraid	0.836801	0.271097
oversight*~finmanage*~sweatequity*govpermit*~floorplan*deteraid	0.836801	0.271097

Pathway 2: ~finmanage*govpermit*~floorplan*deteraid*~location*value

Subset	Consistency	Coverage
deteraid*value	0.924529	0.603679
govpermit*deteraid*value	0.923069	0.59129
deteraid*~location*value	0.914679	0.327107
govpermit*deteraid*~location*value	0.914679	0.327107
~floorplan*deteraid*~location*value	0.914679	0.327107
~finmanage*deteraid*~location*value	0.914679	0.327107
~finmanage*govpermit*deteraid*~location*value	0.914679	0.327107
govpermit*~floorplan*deteraid*~location*value	0.914679	0.327107
~finmanage*~floorplan*deteraid*~location*value	0.914679	0.327107
~finmanage*govpermit*~floorplan*deteraid*~location*value	0.914679	0.327107

Pathway 3: oversight*procurement*~sweatequity*govpermit*~floorplan*location

Subset	Consistency	Coverage
oversight*~floorplan*location	0.906256	0.313696
oversight*govpermit*~floorplan*location	0.906256	0.313696
oversight*~sweatequity*~floorplan*location	0.906256	0.313696
oversight*~sweatequity*govpermit*~floorplan*location	0.906256	0.313696
procurement*~floorplan	0.873481	0.224026
procurement*~floorplan*location	0.873481	0.224026
oversight*procurement*~floorplan	0.873481	0.224026
procurement*govpermit*~floorplan	0.873481	0.224026
procurement*~sweatequity*~floorplan	0.873481	0.224026
procurement*govpermit*~floorplan*location	0.873481	0.224026
oversight*procurement*~floorplan*location	0.873481	0.224026

oversight*procurement*govpermit*~floorplan	0.873481	0.224026
procurement*~sweatequity*~floorplan*location	0.873481	0.224026
procurement*~sweatequity*govpermit*~floorplan	0.873481	0.224026
oversight*procurement*~sweatequity*~floorplan	0.873481	0.224026
oversight*procurement*govpermit*~floorplan*location	0.873481	0.224026
oversight*procurement*~sweatequity*~floorplan*location	0.873481	0.224026
procurement*~sweatequity*govpermit*~floorplan*location	0.873481	0.224026
oversight*procurement*~sweatequity*govpermit*~floorplan	0.873481	0.224026
oversight*procurement*~sweatequity*govpermit*~floorplan*location	0.873481	0.224026

Pathway 4: oversight*~finmanage*~sweatequity*govpermit*deteraid*location*value

Subset	Consistency	Coverage
oversight*location*value	1	0.377111
oversight*govpermit*location*value	1	0.371856
oversight*~sweatequity*location*value	1	0.359506
oversight*~sweatequity*govpermit*location*value	1	0.354252
oversight*~finmanage*location*value	1	0.269799
oversight*~finmanage*~sweatequity*location*value	1	0.269799
oversight*~finmanage*govpermit*location*value	1	0.267109
oversight*~finmanage*~sweatequity*govpermit*location*value	1	0.267109
oversight*deteraid*location*value	1	0.254218
oversight*~sweatequity*deteraid*location*value	1	0.251325
oversight*govpermit*deteraid*location*value	1	0.248963
oversight*~sweatequity*govpermit*deteraid*location*value	1	0.246071
oversight*~finmanage*deteraid*location*value	1	0.16485
oversight*~finmanage*~sweatequity*deteraid*location*value	1	0.16485
oversight*~finmanage*govpermit*deteraid*location*value	1	0.16216
oversight*~finmanage*~sweatequity*govpermit*deteraid*location*value	1	0.16216

Pathway 5: oversight*procurement*~sweatequity*govpermit*deteraid*location*value

Subset	Consistency	Coverage
oversight*location*value	1	0.377111
oversight*govpermit*location*value	1	0.371856
oversight*~sweatequity*location*value	1	0.359506
oversight*~sweatequity*govpermit*location*value	1	0.354252
procurement*value	1	0.257692
procurement*location*value	1	0.257692
oversight*procurement*value	1	0.257692
oversight*procurement*location*value	1	0.257692
procurement*govpermit*value	1	0.255127
procurement*govpermit*location*value	1	0.255127
oversight*procurement*govpermit*value	1	0.255127
oversight*procurement*govpermit*location*value	1	0.255127
oversight*deteraid*location*value	1	0.254218
oversight*~sweatequity*deteraid*location*value	1	0.251325
oversight*govpermit*deteraid*location*value	1	0.248963
oversight*~sweatequity*govpermit*deteraid*location*value	1	0.246071
procurement*~sweatequity*value	1	0.240087
procurement*~sweatequity*location*value	1	0.240087
oversight*procurement*~sweatequity*value	1	0.240087
oversight*procurement*~sweatequity*location*value	1	0.240087
procurement*~sweatequity*govpermit*value	1	0.237523
procurement*~sweatequity*govpermit*location*value	1	0.237523
oversight*procurement*~sweatequity*govpermit*value	1	0.237523

oversight*procurement*~sweatequity*govpermit*location*value	1	0.237523
procurement*deteraid*value	1	0.163725
procurement*deteraid*location*value	1	0.163725
oversight*procurement*deteraid*value	1	0.163725
oversight*procurement*deteraid*location*value	1	0.163725
procurement*govpermit*deteraid*value	1	0.16116
procurement*govpermit*deteraid*location*value	1	0.16116
oversight*procurement*govpermit*deteraid*value	1	0.16116
oversight*procurement*govpermit*deteraid*location*value	1	0.16116
procurement*~sweatequity*deteraid*value	1	0.160832
procurement*~sweatequity*deteraid*location*value	1	0.160832
oversight*procurement*~sweatequity*deteraid*value	1	0.160832
oversight*procurement*~sweatequity*deteraid*location*value	1	0.160832
procurement*~sweatequity*govpermit*deteraid*value	1	0.158268
procurement*~sweatequity*govpermit*deteraid*location*value	1	0.158268
oversight*procurement*~sweatequity*govpermit*deteraid*value	1	0.158268
oversight*procurement*~sweatequity*govpermit*deteraid*location*value	1	0.158268

Sweat equity and procurement do not appear on any of the reduced subsets. As such, these conditions can be removed from the analysis, in part because these may occur too late to have influence over design decisions. Financial management similarly is absent from many of the subsets, however, I expect this may provide explanatory power for the cases. I also modify my earlier assumption for financial management upon closer inspection of the cases where it occurs.

Revised Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
oversight*govpermit*~floorplan*deteraid	0.503039	0.0583	0.866644	Poblacion, Sillon, Maricaban, Tagpuro, Cogon
oversight*govpermit*~floorplan*location	0.313696	0.157497	0.906256	Kangkaibe, Cantahay
govpermit*~floorplan*deteraid*~location*value	0.327107	0.038568	0.914679	Poblacion, Maricaban, Pago, Sillon
oversight*govpermit*deteraid*location*value	0.248963	0.105273	1	Sagkahan (62), Sulangan, San Jose (83C)

solution coverage: 0.804376

solution consistency: 0.879839

The revised solution is significantly more parsimonious while also slightly increasing the solution coverage. The new solution reveals that government permitting, oversight, location, and determination of aid are central. The bottom two pathways show that value of assistance is important, but not sufficient, demonstrated by two alternative pathways. Further, while lack of floorplan input is in 3 of the 4 pathways, the third pathway demonstrates that household input and improved designs can still be achieved.

Absence of Safe Shelter Design

I again begin by analyzing the necessity and sufficiency of individual conditions to the absence of shelter design. In this case, I find that one condition, the absence of value of aid, is necessary in the absence of design. This supports the earlier analysis which includes value in 2 of the 4 pathways. While the absence of procurement appears as a condition for the absence of design, this condition was removed from earlier design pathways after subset/superset analysis. Similarly, this condition may be insignificant for the absence of design, pending adequate subset/superset analysis.

Table F-7: Necessity and Sufficiency of Absence of Shelter Design Outcome

Condition	Necessity	Coverage
~Value of Aid	0.828712	0.763674
~Procurement	0.728270	0.483382
Floorplan and Layout	0.587949	0.691171
~Financial Management	0.580126	0.388039
~Floorplan and Layout	0.567388	0.419878
~Oversight	0.527811	0.785221
~Government Permitting	0.497381	0.858344
Financial Management	0.472367	0.668178
Sweat Equity	0.422724	0.578056
~Determination of Aid	0.372934	0.554812
~Location Selection	0.196485	0.282566

Assumptions:

- Oversight (absent)
- Financial Management (present or absent)
- Procurement (absent)
- Sweat Equity (present)
- Government permitting (absent)
- Floorplan and Layout (present or absent)
- Determination of Aid (absent)
- Location Selection (absent)
- Value (absent)

Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
finmanage*floorplan*~value	0.462788	0.462788	0.890790	San Jose (85), Hiabangan, Sungko, New Kawayan (101), Magallanes (52)
~oversight*~finmanage*~procurement* ~sweatequity*~floorplan*deteraid	0.062831	0.062832	0.809179	Okoy
~oversight*~finmanage*~procurement* sweatequity*~govpermit*~floorplan*~deteraid	0.077648	0.077648	1.000000	San Agustin

solution coverage: 0.603268

solution consistency: 0.893965

The solution provides excellent consistency and moderate coverage, despite complex pathways for the last two cases. In order to seek more parsimonious solutions, I next perform subset/superset analysis in order to seek clarity in the solution.

Subset/Superset Analysis

In order to examine ways to reduce the complexity of the above pathways, I examine subsets of the outcomes, in this case, the absence of shelter design. A list of subsets for the 3 pathways are shown below. Combinations of conditions are listed for all subsets higher than the original pathway, if such subsets exist. If such a subset does not exist, then up to 5 subsets greater than the consistency cutoff value of 0.8, are listed.

Pathway 1: finmanage*floorplan*~value

Subset	Consistency	Coverage
~value*floorplan	0.850194	0.587949
~value*finmanage	0.823576	0.472367
value*floorplan*finmanage	0.89079	0.462788

Pathway 2: ~oversight*~finmanage*~procurement*~sweatequity*~floorplan*deteraid

Subset	Consistency	Coverage
~oversight*~sweatequity	0.9118	0.388871
~oversight*~procurement*~sweatequity	0.892168	0.311223
~oversight*~sweatequity*deteraid	0.952295	0.295777
~oversight*~procurement*~sweatequity*deteraid	0.936393	0.218128
~oversight*~finmanage*~sweatequity	0.835241	0.190694
~oversight*~finmanage*~procurement*~sweatequity	0.835241	0.190694
~oversight*~finmanage*~sweatequity*deteraid	0.868196	0.097599

~oversight*~finmanage*~procurement*~sweatequity*deteraid	0.868196	0.097599
~oversight*~sweatequity*~floorplan*deteraid	0.809179	0.062831
~oversight*~finmanage*~sweatequity*~floorplan*deteraid	0.809179	0.062831
~oversight*~procurement*~sweatequity*~floorplan*deteraid	0.809179	0.062831
~oversight*~finmanage*~procurement*~sweatequity*~floorplan*deteraid	0.809179	0.062831

Pathway 3: ~oversight*~finmanage*~procurement*sweatequity*~govpermit*~floorplan*~deteraid

Subset	**Consistency**	**Coverage**
sweatequity*~govpermit	1	0.192383
~oversight*sweatequity*~govpermit	1	0.192383
~procurement*sweatequity*~govpermit	1	0.154138
~oversight*~procurement*sweatequity*~govpermit	1	0.154138
~finmanage*sweatequity*~govpermit	1	0.112416
~oversight*~finmanage*sweatequity*~govpermit	1	0.112416
~finmanage*~procurement*sweatequity*~govpermit	1	0.112416
~oversight*~finmanage*~procurement*sweatequity*~govpermit	1	0.112416
sweatequity*~govpermit*~deteraid	1	0.077648
sweatequity*~govpermit*~floorplan	1	0.077648
~finmanage*sweatequity*~govpermit*~deteraid	1	0.077648
sweatequity*~govpermit*~floorplan*~deteraid	1	0.077648
~oversight*sweatequity*~govpermit*~deteraid	1	0.077648
~finmanage*sweatequity*~govpermit*~floorplan	1	0.077648
~oversight*sweatequity*~govpermit*~floorplan	1	0.077648
~procurement*sweatequity*~govpermit*~deteraid	1	0.077648
~procurement*sweatequity*~govpermit*~floorplan	1	0.077648
~finmanage*sweatequity*~govpermit*~floorplan*~deteraid	1	0.077648
~oversight*sweatequity*~govpermit*~floorplan*~deteraid	1	0.077648
~oversight*~finmanage*sweatequity*~govpermit*~deteraid	1	0.077648
~oversight*~finmanage*sweatequity*~govpermit*~floorplan	1	0.077648
~procurement*sweatequity*~govpermit*~floorplan*~deteraid	1	0.077648
~finmanage*~procurement*sweatequity*~govpermit*~deteraid	1	0.077648
~oversight*~procurement*sweatequity*~govpermit*~deteraid	1	0.077648
~finmanage*~procurement*sweatequity*~govpermit*~floorplan	1	0.077648
~oversight*~procurement*sweatequity*~govpermit*~floorplan	1	0.077648
~oversight*~finmanage*sweatequity*~govpermit*~floorplan*~deteraid	1	0.077648
~finmanage*~procurement*sweatequity*~govpermit*~floorplan*~deteraid	1	0.077648
~oversight*~finmanage*~procurement*sweatequity*~govpermit*~deteraid	1	0.077648
~oversight*~procurement*sweatequity*~govpermit*~floorplan*~deteraid	1	0.077648
~oversight*~finmanage*~procurement*sweatequity*~govpermit*~floorplan	1	0.077648
~oversight*~finmanage*~procurement*sweatequity*~govpermit*~floorplan*~deteraid	1	0.077648

From the subset/superset analysis it becomes clear that there are few conditions that can be removed. Location selection, determination of aid, and procurement are potential candidates for removal, however removing any of these would decrease the solution coverage, while minimally increasing an already excellent coverage. These last two pathways are specific to the selected cases and thus are hard to generalize, however the first pathway shows promise given its parsimony and large number of cases that are encompassed by its conditions. As such, I do not change or reduce the conditions in my analysis.

Shelter Adaptations

I again start by analyzing the individual condition necessity and sufficiency in relation to the adaptation outcome. This outcome examines whether households made improvements or expansions to their shelter within the first 12 months after completion.

For this outcome, 5 simplifying assumptions could be made during the Boolean minimization process. Location selection and government permitting were assumed to be present, as these are linked to land tenure and permanency of structures. Sweat equity is assumed to also be present for this outcome as there is significant past theory to support that its role in instilling ownership. Both determination of aid and floorplan and layout were assumed to be absent as these neglect household preferences which is likely to lead to needed modifications to shelter. I did not have substantive or theoretical knowledge to inform assumptions on the remaining conditions, thus I did not specify a directional link in my analysis.

Table F-8: Necessity and Sufficiency of Adaptation Outcome

Presence of Condition	**Necessity**	**Coverage**
~Procurement	0.779817	0.653846
Government Permitting	0.752294	0.585714
~Financial Management	0.743119	0.627907
Location Selection	0.688073	0.576923
~Floorplan and Layout	0.688073	0.643225
Oversight	0.678899	0.560606
Value of Aid	0.660901	0.747554
~Value of Aid	0.528019	0.614665
Sweat Equity	0.396330	0.684628
~Determination of Aid	0.366972	0.689655
~Oversight	0.348624	0.655172
Financial Management	0.284404	0.508197
Procurement	0.220183	0.400000

Assumptions:

- Oversight (present or absent)
- Financial Management (present or absent)
- Procurement (present or absent)
- Sweat Equity (present)
- Government permitting (present)
- Floorplan and Layout (absent)
- Determination of Aid (absent)
- Location Selection (present)
- Value (present or absent)

Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
oversight*finmanage*~procurement*location*~value	0.064220	0.064220	1.000000	New Kawayan (101)
~finmanage*~procurement*govpermit*~floorplan*location*value	0.154357	0.063531	0.976339	Bagacay (93), Okoy
oversight*~finmanage*~procurement*govpermit*location*value	0.111068	0.025747	1.000000	San Jose (83C)
~oversight*~finmanage*~procurement*sweatequity*govpermit*~floorplan*value	0.124771	0.064220	1.000000	Pago
oversight*procurement*govpermit*~floorplan*~deteraid*location*~value	0.121599	0.121599	1.000000	Cantahay, Kangkaibe
~oversight*~finmanage*~procurement*sweatequity*~floorplan*~deteraid*location*value	0.113820	0.05602	1.000000	San Agustin

solution coverage: 0.486165

solution consistency: 0.992364

Subset/Superset Analysis

In order to examine ways to reduce the complexity of the above pathways, I examine subsets of the outcomes, in this case, adaptations to shelters. A list of subsets for the 6 pathways are shown below. Combinations of conditions are listed for all subsets higher than the original pathway, if such subsets exist. If such a subset does not exist, then up to 5 subsets greater than the consistency cutoff value of 0.8, are listed.

Pathway 1: oversight*finmanage*~procurement*location*~value

Subset	Consistency	Coverage
oversight*~procurement*location*~value	1	0.17621
oversight*finmanage*~procurement	1	0.06422
oversight*finmanage*~procurement*~value	1	0.06422
oversight*finmanage*~procurement*location	1	0.06422

oversight*finmanage*~procurement*location*~value	1	0.06422

Pathway 2: ~finmanage*~procurement*govpermit*~floorplan*location*value

Subset	Consistency	Coverage
~finmanage*~procurement*location*value	0.984776	0.241985
~procurement*~floorplan*location*value	0.982529	0.210379
~finmanage*~procurement*~floorplan*location*value	0.982529	0.210379
~procurement*govpermit*location*value	0.979652	0.180104
~finmanage*~procurement*govpermit*location*value	0.979652	0.180104
~procurement*govpermit*~floorplan*location*value	0.976339	0.154357
~finmanage*~procurement*govpermit*~floorplan*location*value	0.976339	0.154357

Pathway 3: oversight*~finmanage*~procurement*govpermit*location*value

Subset	Consistency	Coverage
oversight*~procurement*location*value	1	0.113628
oversight*~procurement*govpermit*location*value	1	0.111068
oversight*~finmanage*~procurement*location*value	1	0.113628
oversight*~finmanage*~procurement*govpermit*location*value	1	0.111068

Pathway 4: ~oversight*~finmanage*~procurement*sweatequity*govpermit*~floorplan*value

Subset	Consistency	Coverage
~oversight*~finmanage*value	1	0.247624
~oversight*~finmanage*~procurement*value	1	0.247624
~oversight*~floorplan*value	1	0.244324
~oversight*~finmanage*~floorplan*value	1	0.244324
~oversight*~procurement*~floorplan*value	1	0.244324
~oversight*~finmanage*~procurement*~floorplan*value	1	0.244324
~oversight*~finmanage*sweatequity	1	0.213761
~oversight*~finmanage*~procurement*sweatequity	1	0.213761
~oversight*govpermit	1	0.192661
~oversight*~finmanage*govpermit	1	0.192661
~oversight*~procurement*govpermit	1	0.192661
~oversight*~finmanage*~procurement*govpermit	1	0.192661
~oversight*govpermit*~floorplan	1	0.189908
~oversight*~finmanage*govpermit*~floorplan	1	0.189908
~oversight*~procurement*govpermit*~floorplan	1	0.189908
~oversight*~finmanage*~procurement*govpermit*~floorplan	1	0.189908
~oversight*govpermit*value	1	0.188302
~oversight*~finmanage*govpermit*value	1	0.188302
~oversight*govpermit*~floorplan*value	1	0.188302
~oversight*~procurement*govpermit*value	1	0.188302
~oversight*~finmanage*govpermit*~floorplan*value	1	0.188302
~oversight*~procurement*govpermit*~floorplan*value	1	0.188302
~oversight*~finmanage*~procurement*govpermit*value	1	0.188302
~oversight*~finmanage*~procurement*govpermit*~floorplan*value	1	0.188302
~oversight*sweatequity*~floorplan	1	0.186239
~oversight*~finmanage*sweatequity*~floorplan	1	0.186239
~oversight*~procurement*sweatequity*~floorplan	1	0.186239
~oversight*~finmanage*~procurement*sweatequity*~floorplan	1	0.186239
~oversight*~finmanage*sweatequity*value	1	0.184093
~oversight*~finmanage*~procurement*sweatequity*value	1	0.184093
~oversight*sweatequity*~floorplan*value	1	0.180793
~oversight*~finmanage*sweatequity*~floorplan*value	1	0.180793

~oversight*~procurement*sweatequity*~floorplan*value	1	0.180793
~oversight*~finmanage*~procurement*sweatequity*~floorplan*value	1	0.180793
~oversight*sweatequity*govpermit	1	0.124771
~oversight*sweatequity*govpermit*value	1	0.124771
~oversight*sweatequity*govpermit*~floorplan	1	0.124771
~oversight*~finmanage*sweatequity*govpermit	1	0.124771
~oversight*~procurement*sweatequity*govpermit	1	0.124771
~oversight*~finmanage*sweatequity*govpermit*value	1	0.124771
~oversight*sweatequity*govpermit*~floorplan*value	1	0.124771
~oversight*~procurement*sweatequity*govpermit*value	1	0.124771
~oversight*~finmanage*sweatequity*govpermit*~floorplan	1	0.124771
~oversight*~procurement*sweatequity*govpermit*~floorplan	1	0.124771
~oversight*~finmanage*~procurement*sweatequity*govpermit	1	0.124771
~oversight*~finmanage*sweatequity*govpermit*~floorplan*value	1	0.124771
~oversight*~finmanage*~procurement*sweatequity*govpermit*value	1	0.124771
~oversight*~procurement*sweatequity*govpermit*~floorplan*value	1	0.124771
~oversight*~finmanage*~procurement*sweatequity*govpermit*~floorplan	1	0.124771
~oversight*~finmanage*~procurement*sweatequity*govpermit*~floorplan*value	1	0.124771

Pathway 5: oversight*procurement*govpermit*~floorplan*~deteraid*location*~value

Subset	Consistency	Coverage
~deteraid*location*~value	1	0.208626
~floorplan*~deteraid*location*~value	1	0.208626
oversight*~deteraid*location*~value	1	0.172905
govpermit*~deteraid*location*~value	1	0.172905
oversight*govpermit*~deteraid*location*~value	1	0.172905
oversight*~floorplan*~deteraid*location*~value	1	0.172905
govpermit*~floorplan*~deteraid*location*~value	1	0.172905
oversight*govpermit*~floorplan*~deteraid*location*~value	1	0.172905
procurement*~deteraid*~value	1	0.121599
procurement*~deteraid*location*~value	1	0.121599
oversight*procurement*~deteraid*~value	1	0.121599
procurement*govpermit*~deteraid*~value	1	0.121599
procurement*~floorplan*~deteraid*~value	1	0.121599
procurement*govpermit*~deteraid*location*~value	1	0.121599
oversight*procurement*~deteraid*location*~value	1	0.121599
oversight*procurement*govpermit*~deteraid*~value	1	0.121599
procurement*~floorplan*~deteraid*location*~value	1	0.121599
oversight*procurement*~floorplan*~deteraid*~value	1	0.121599
procurement*govpermit*~floorplan*~deteraid*~value	1	0.121599
oversight*procurement*govpermit*~deteraid*location*~value	1	0.121599
procurement*govpermit*~floorplan*~deteraid*location*~value	1	0.121599
oversight*procurement*~floorplan*~deteraid*location*~value	1	0.121599
oversight*procurement*govpermit*~floorplan*~deteraid*~value	1	0.121599
oversight*procurement*govpermit*~floorplan*~deteraid*location*~value	1	0.121599

Pathway 6: oversight*~finmanage*~procurement*sweatequity*~floorplan*~deteraid*location*value

Subset	Consistency	Coverage
sweatequity*~deteraid*location	1	0.177064
~finmanage*sweatequity*location	1	0.177064
sweatequity*~deteraid*location*value	1	0.171618
oversight*~deteraid*location*value	1	0.15798

~finmanage*~procurement*sweatequity*location	1	0.149541
~finmanage*sweatequity*location*value	1	0.147395
~finmanage*sweatequity*~deteraid*location	1	0.146789
~finmanage*sweatequity*~deteraid*location*value	1	0.141343
oversight*~finmanage*~deteraid*location*value	1	0.127382
~finmanage*~procurement*sweatequity*location*value	1	0.119872
~procurement*sweatequity*~deteraid*location	1	0.119266
~finmanage*~procurement*sweatequity*~deteraid*location	1	0.119266
~procurement*sweatequity*~deteraid*location*value	1	0.11382
~finmanage*~procurement*sweatequity*~deteraid*location*value	1	0.11382
oversight*~procurement*location*value	1	0.113628
oversight*~finmanage*~procurement*location*value	1	0.113628
oversight*sweatequity*~deteraid*location	1	0.112844
oversight*sweatequity*~deteraid*location*value	1	0.112844
oversight*~finmanage*sweatequity*location	1	0.082569
oversight*~finmanage*sweatequity*location*value	1	0.082569
oversight*~finmanage*sweatequity*~deteraid*location	1	0.082569
oversight*~finmanage*sweatequity*~deteraid*location*value	1	0.082569
oversight*~procurement*~deteraid*location	1	0.055046
oversight*~procurement*sweatequity*location	1	0.055046
oversight*~procurement*~deteraid*location*value	1	0.055046
oversight*~procurement*sweatequity*location*value	1	0.055046
oversight*~finmanage*~procurement*~deteraid*location	1	0.055046
oversight*~procurement*sweatequity*~deteraid*location	1	0.055046
oversight*~finmanage*~procurement*sweatequity*location	1	0.055046
oversight*~finmanage*~procurement*~deteraid*location*value	1	0.055046
oversight*~procurement*sweatequity*~deteraid*location*value	1	0.055046
oversight*~finmanage*~procurement*sweatequity*location*value	1	0.055046
oversight*~finmanage*~procurement*sweatequity*~deteraid*location	1	0.055046
oversight*~finmanage*~procurement*sweatequity*~deteraid*location*value	1	0.055046

In examining the subsets closely, we can see that determination of aid only appears in the fifth and sixth pathways. In examine the cases more closely, the participation of households in early assessment did not play a role in household decisions to expand or improve shelter in either of these projects, thus I remove this condition from my analysis. Similarly, when I examine floorplan and layout, this condition only appears in pathway 4 and when the case that falls into this pathway is examined more closely, the other conditions are more representative of rationale for improvements made by households. While procurement occurs in pathway 2 and 4, a closer look at the cases reveals that this did not play a larger role in why households expanded, thus I also remove it. Finally, sweat equity fall into a similar situation, thus it also removed. The remaining conditions were then analyzed again to reduce the complexity of the pathways.

Revised Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
~oversight*~finmanage*govpermit*value	0.188302	0.06422	1	Pago, Bagacay (93), Okoy
~oversight*~finmanage*location*value	0.183403	0.059322	1	Bagacay (93), Okoy, San Agustin
oversight*~finmanage*govpermit*location* ~value	0.161479	0.082651	0.884955	Kangkaibe
oversight*finmanage*govpermit*location*value	0.108817	0.081294	0.855545	Sulangan

solution coverage: 0.439092

solution consistency: 0.917724

From the revised pathways, we can see that there is significantly greater parsimony, despite only moderate decreases in coverage and consistency of the solution. While the solution coverage is relatively low, this may stem from external factors that were not considered in my analysis, as the focus on solely on the role of participation in influencing adaptations. Consideration of other conditions, such as household socio-economic status and status of land tenure may provide greater coverage had these been included.

Absence of Shelter Adaptations

I again start by analyzing the individual condition necessity and sufficiency in relation to the absence of the adaptation outcome.

Assumptions:

- Oversight (present or absent)
- Financial Management (present or absent)
- Procurement (present or absent)
- Sweat Equity (absent)
- Government permitting (absent)
- Floorplan and Layout (present)
- Determination of Aid (present)
- Location Selection (absent)
- Value (present or absent)

Table F-9: Necessity and Sufficiency of Absence of Adaptation Outcome

Presence of Condition	Necessity	Coverage
Determination of Aid	0.777778	0.477273
~Sweat Equity	0.754321	0.481481
Oversight	0.753086	0.462121
~Value of Aid	0.699667	0.605256
~Financial Management	0.629630	0.395349
~Procurement	0.555556	0.346154
Value of Aid	0.554559	0.466136
Floorplan and Layout	0.486420	0.536785
Procurement	0.444444	0.600000
Financial Management	0.407407	0.540984
~Location Selection	0.320988	0.433333
~Government Permitting	0.283951	0.460000
~Oversight	0.283951	0.396552

Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
finmanage*procurement*~sweatequity*~govpermit*floorplan*deteraid*~value	0.082716	0.045679	1.000000	San Jose (85)
oversight*finmanage*procurement*~sweatequity*floorplan*deteraid*~value	0.119753	0.082716	0.868073	Magallanes (52)
oversight*~finmanage*procurement*~sweatequity*floorplan*deteraid*value	0.082716	0.082716	1.000000	Sagkahan (62)

solution coverage: 0.248148

solution consistency: 0.931669

Subset/Superset Analysis

In order to examine ways to reduce the complexity of the above pathways, I examine subsets of the outcomes, in this case, the absence of adaptations to shelters. A list of subsets for the 3 pathways are shown below. Combinations of conditions are listed for all subsets higher than the original pathway, if such subsets exist. If such a subset does not exist, then up to 5 subsets greater than the consistency cutoff value of 0.8, are listed.

Pathway 1: finmanage*procurement*~sweatequity*~govpermit*floorplan*deteraid*~value

Subset	Consistency	Coverage
procurement*~govpermit	1	0.123457
procurement*~govpermit*deteraid	1	0.123457
finmanage*procurement*~govpermit	1	0.123457

procurement*~govpermit*floorplan	1	0.123457
procurement*~govpermit*floorplan*deteraid	1	0.123457
finmanage*procurement*~govpermit*deteraid	1	0.123457
finmanage*procurement*~govpermit*floorplan	1	0.123457
finmanage*procurement*~govpermit*floorplan*deteraid	1	0.123457
procurement*~govpermit*~value	1	0.120173
procurement*~govpermit*deteraid*~value	1	0.120173
procurement*~govpermit*floorplan*~value	1	0.120173
finmanage*procurement*~govpermit*~value	1	0.120173
finmanage*procurement*~govpermit*deteraid*~value	1	0.120173
procurement*~govpermit*floorplan*deteraid*~value	1	0.120173
finmanage*procurement*~govpermit*floorplan*~value	1	0.120173
finmanage*procurement*~govpermit*floorplan*deteraid*~value	1	0.120173
procurement*~sweatequity*~govpermit	1	0.082716
procurement*~sweatequity*~govpermit*~value	1	0.082716
procurement*~sweatequity*~govpermit*deteraid	1	0.082716
finmanage*procurement*~sweatequity*~govpermit	1	0.082716
procurement*~sweatequity*~govpermit*floorplan	1	0.082716
procurement*~sweatequity*~govpermit*deteraid*~value	1	0.082716
procurement*~sweatequity*~govpermit*floorplan*~value	1	0.082716
finmanage*procurement*~sweatequity*~govpermit*~value	1	0.082716
procurement*~sweatequity*~govpermit*floorplan*deteraid	1	0.082716
finmanage*procurement*~sweatequity*~govpermit*deteraid	1	0.082716
finmanage*procurement*~sweatequity*~govpermit*floorplan	1	0.082716
finmanage*procurement*~sweatequity*~govpermit*deteraid*~value	1	0.082716
procurement*~sweatequity*~govpermit*floorplan*deteraid*~value	1	0.082716
finmanage*procurement*~sweatequity*~govpermit*floorplan*~value	1	0.082716
finmanage*procurement*~sweatequity*~govpermit*floorplan*deteraid	1	0.082716
finmanage*procurement*~sweatequity*~govpermit*floorplan*deteraid*~value	1	0.082716

Pathway 2: oversight*finmanage*procurement*~sweatequity*floorplan*deteraid*~value

Subset	Consistency	Coverage
procurement*floorplan*~value	0.924492	0.268175
procurement*deteraid*~value	0.931414	0.247155
finmanage*procurement*floorplan*~value	0.916345	0.239926
procurement*floorplan*deteraid*~value	0.927008	0.231138
procurement*~sweatequity*floorplan*~value	0.913296	0.230718
finmanage*procurement*deteraid*~value	0.923242	0.218905
finmanage*procurement*floorplan*deteraid*~value	0.917682	0.202889
finmanage*procurement*~sweatequity*floorplan*~value	0.902379	0.202469
procurement*~sweatequity*deteraid*~value	0.914104	0.193681
procurement*~sweatequity*floorplan*deteraid*~value	0.914104	0.193681
oversight*procurement*floorplan*~value	0.894157	0.185039
oversight*procurement*~sweatequity*floorplan*~value	0.894157	0.185039
finmanage*procurement*~sweatequity*deteraid*~value	0.90089	0.165432
finmanage*procurement*~sweatequity*floorplan*deteraid*~value	0.90089	0.165432
oversight*procurement*deteraid*~value	0.900121	0.164018
oversight*finmanage*procurement*floorplan*~value	0.877425	0.15679
oversight*finmanage*procurement*~sweatequity*floorplan*~value	0.877425	0.15679
oversight*procurement*floorplan*deteraid*~value	0.890496	0.148002
oversight*procurement*~sweatequity*deteraid*~value	0.890496	0.148002
oversight*procurement*~sweatequity*floorplan*deteraid*~value	0.890496	0.148002
oversight*finmanage*procurement*deteraid*~value	0.881796	0.135769
oversight*finmanage*procurement*floorplan*deteraid*~value	0.868073	0.119753

oversight*finmanage*procurement*~sweatequity*deteraid*~value	0.868073	0.119753
oversight*finmanage*procurement*~sweatequity*floorplan*deteraid*~value	0.868073	0.119753

Pathway 3: oversight*~finmanage*procurement*~sweatequity*floorplan*deteraid*value

Subset	Consistency	Coverage
~finmanage*procurement*deteraid	1	0.123457
oversight*~finmanage*procurement*deteraid	1	0.123457
~finmanage*procurement*~sweatequity*deteraid	1	0.123457
oversight*~finmanage*procurement*~sweatequity*deteraid	1	0.123457
~finmanage*procurement*floorplan	1	0.119753
~finmanage*procurement*floorplan*value	1	0.119753
oversight*~finmanage*procurement*floorplan	1	0.119753
~finmanage*procurement*~sweatequity*floorplan	1	0.119753
oversight*~finmanage*procurement*floorplan*value	1	0.119753
~finmanage*procurement*~sweatequity*floorplan*value	1	0.119753
oversight*~finmanage*procurement*~sweatequity*floorplan	1	0.119753
oversight*~finmanage*procurement*~sweatequity*floorplan*value	1	0.119753
~finmanage*procurement*deteraid*value	1	0.095208
oversight*~finmanage*procurement*deteraid*value	1	0.095208
~finmanage*procurement*~sweatequity*deteraid*value	1	0.095208
oversight*~finmanage*procurement*~sweatequity*deteraid*value	1	0.095208
~finmanage*procurement*floorplan*deteraid	1	0.082716
~finmanage*procurement*floorplan*deteraid*value	1	0.082716
oversight*~finmanage*procurement*floorplan*deteraid	1	0.082716
~finmanage*procurement*~sweatequity*floorplan*deteraid	1	0.082716
oversight*~finmanage*procurement*floorplan*deteraid*value	1	0.082716
~finmanage*procurement*~sweatequity*floorplan*deteraid*value	1	0.082716
oversight*~finmanage*procurement*~sweatequity*floorplan*deteraid	1	0.082716
oversight*~finmanage*procurement*~sweatequity*floorplan*deteraid*value	1	0.082716

From the subset/superset analysis we can see that sweat equity, location selection, and oversight are not in subsets of the three pathways. These are thus removed from the second iteration of analysis.

Revised Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
value*deteraid*procurement*floorplan*~finmanage	0.082716	0.082716	1.000000	Sagkahan (62)
~value*deteraid*procurement*floorplan*finmanage	0.202889	0.202889	0.917682	San Jose (85), Magallanes (52)

solution coverage: 0.285605

solution consistency: 0.940094

The revised intermediate solution still has low coverage, but this again may be linked to external conditions that were not considered in this analysis, as the focus was on the role of participation in shelter adaptations. Interesting, the 2 pathways that surface are distinguished by financial management with low value of assistance and the inverse, suggesting that it is important to link these in order to avoid the absence of adaptations. This also confirms a similar trend observed in the case of the presence of adaptations.

Household Savings

Following the previously outlined steps, I first investigate the necessity and coverage of individual conditions posited to affect household savings. A summary of this analysis can be found in Table F-10 below. For this condition, I do not have strong evidence to make an assumption for sweat equity, as the reduced labor costs could save money, but also burden households. For all of the remaining conditions, I make a directional assumption to household savings.

We would obviously expect more value of aid to increase household savings as this provides more resources at the disposal of households. The presence of location is expected to result in the presence of the outcome as closer proximity and knowledge of markets and socials ties increases resources at the disposal of households. Determination of aid and floorplan and layout both offer households more choice which promotes more tailors shelter assistance, thus the presence of these will result in the presence of the outcome. Government permitting allows for more secure land tenure as well as input into shelter designs which reduces the need to make essential modifications to shelter, thus I assume that its presence occurs in the presence of household savings. Procurement, financial management, and oversight all ensure that households have control over the construction phase which should lead to high quality shelter, reducing the need again to alter replace or change shelters.

Table F-10: Necessity and Sufficiency of Household Savings Outcome

Presence of Condition	Necessity	Coverage
Determination of Aid	0.889988	0.545455
~Sweat Equity	0.881335	0.561860
Oversight	0.819530	0.502273
Location Selection	0.770087	0.479231
Government Permitting	0.690977	0.399286
Value of Aid	0.638715	0.536211
Floorplan and Layout	0.636588	0.701635
Financial Management	0.448702	0.595082
Procurement	0.347342	0.468333
Sweat Equity	0.333745	0.427892

Assumptions:

- Oversight (present)
- Financial Management (present)
- Procurement (present)
- Sweat Equity (present or absent)
- Government permitting (present)
- Floorplan and Layout (present)
- Determination of Aid (present)
- Location Selection (present)
- Value (present)

Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
oversight*finmanage*~sweatequity*floorplan*deteraid*location	0.258344	0.150770	0.893162	New Kawayan (101), Magallanes (52), Sulangan
oversight*~sweatequity*govpermit*floorplan*deteraid*location*value	0.284414	0.176840	0.938798	Sagkahan (62), Sulangan, San Jose (83C)

solution coverage: 0.435184

solution consistency: 0.897976

Subset/Superset Analysis

In order to examine ways to reduce the complexity of the above pathways, I examine subsets of the outcomes, in this case, household savings. A list of subsets for the 2 pathways are shown below. Combinations of conditions are listed for all subsets higher than the original pathway, if such subsets exist. If such a subset does not exist, then up to 5 subsets greater than the consistency cutoff value of 0.8, are listed.

Pathway 1: oversight*finmanage*~sweatequity*floorplan*deteraid*location

Subset	Consistency	Coverage
oversight*floorplan*deteraid	0.89486	0.473424
oversight*floorplan*deteraid*location	0.89486	0.473424
oversight*~sweatequity*floorplan*deteraid	0.89486	0.473424
oversight*~sweatequity*floorplan*deteraid*location	0.89486	0.473424
oversight*finmanage*floorplan*deteraid	0.893162	0.258344
oversight*~sweatequity*finmanage*deteraid	0.893162	0.258344
oversight*finmanage*floorplan*deteraid*location	0.893162	0.258344
oversight*~sweatequity*finmanage*deteraid*location	0.893162	0.258344
oversight*~sweatequity*finmanage*floorplan*deteraid	0.893162	0.258344
oversight*~sweatequity*finmanage*floorplan*deteraid*location	0.893162	0.258344

Pathway 2: oversight*~sweatequity*govpermit*floorplan*deteraid*location*value

Subset	Consistency	Coverage
oversight*deteraid*location*value	0.943108	0.307366
oversight*~sweatequity*deteraid*location*value	0.942454	0.303657
oversight*govpermit*deteraid*location*value	0.941908	0.300629
oversight*~sweatequity*govpermit*deteraid*location*value	0.941225	0.296921
oversight*floorplan*deteraid*value	0.94013	0.29115
oversight*floorplan*deteraid*location*value	0.94013	0.29115
oversight*~sweatequity*floorplan*deteraid*value	0.940129	0.29115
oversight*~sweatequity*floorplan*deteraid*location*value	0.940129	0.29115
oversight*govpermit*floorplan*deteraid*value	0.938798	0.284414
oversight*govpermit*floorplan*deteraid*location*value	0.938798	0.284414
oversight*~sweatequity*govpermit*floorplan*deteraid*value	0.938798	0.284414
oversight*~sweatequity*govpermit*floorplan*deteraid*location*value	0.938798	0.284414

In examining the subsets for the 2 pathways, I can see that I can reduce the number of conditions while maintaining the consistency and coverage. In particular, we see that government permitting, procurement, and financial management can be removed from the analysis as more concise subsets present themselves for both initial pathways. While the absence of sweat equity is not in the most parsimonious subsets, it did appear as a necessary condition in the earlier analysis, thus I will leave it in the analysis.

Revised Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
oversight*~sweatequity*floorplan*deteraid* location	0.473424	0.473424	0.894860	New Kawayan (101), San Jose (83C), Sagkahan (62), Magallanes (52), Sulangan, Sulangan

solution coverage: 0.473424

solution consistency: 0.894860

Absence of Household Savings

Similar to the outcome of household savings, I made the inverse assumptions for the selected conditions when considering the absence of household savings. I first investigate necessity and sufficiency of individual conditions. A summary of this analysis can be found in Table F-11 below.

Table F-11: Necessity and Sufficiency of Absence of Household Savings Outcome

Presence of Condition	Necessity	Coverage
~Floorplan and Layout	0.799267	0.747856
~Financial Management	0.773602	0.654264
~Procurement	0.707608	0.593846
~Sweat Equity	0.669111	0.575256
~Value of Aid	0.590347	0.687851
Sweat Equity	0.490376	0.847861
~Determination of Aid	0.450046	0.846552
~Oversight	0.397800	0.748276
~Location Selection	0.379468	0.690000
~Government Permitting	0.229148	0.500000

Assumptions:

- Oversight (absent)
- Financial Management (present)
- Procurement (absent)
- Sweat Equity (absent or absent)
- Government permitting (absent)
- Floorplan and Layout absent)
- Determination of Aid (absent)
- Location Selection (absent)
- Value (absent)

Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
~sweatequity*~floorplan*~deteraid* ~value	0.257989	0.121488	1.000000	Cantahay, Kangkaibe
~finmanage*~procurement*~floorplan* ~location*~value	0.147494	0.076028	0.918188	Tagpuro, Cogon
~oversight*procurement*~sweatequity* ~govpermit*~value	0.061412	0.061412	1.000000	San Jose (85)
~finmanage*~procurement*sweatequity* ~floorplan*~location	0.227314	0.210844	0.826667	Maricaban, Poblacion, Pago
~oversight*~finmanage*~procurement* ~sweatequity*~floorplan*location	0.153071	0.071565	1.000000	Okoy, Bagacay (93)
~oversight*~finmanage*~procurement* ~govpermit*~floorplan*~deteraid*location	0.059578	0.029331	0.650000	San Agustin

solution coverage: 0.723638

solution consistency: 0.886243

Subset/Superset Analysis

In order to examine ways to reduce the complexity of the above pathways, I examine subsets of the outcomes, in this case, the absence of household savings. A list of subsets for the 6 pathways are shown below. Combinations of conditions are listed for all subsets higher than the original pathway, if such subsets exist. If such a subset does not exist, then up to 5 subsets greater than the consistency cutoff value of 0.8, are listed.

Pathway 1: ~sweatequity*~floorplan*~deteraid*~value

Subset	Consistency	Coverage
~deteraid*~value	1	0.269070
~floorplan*~deteraid*~value	1	0.269070
~sweatequity*~deteraid*~value	1	0.257989
~sweatequity*~floorplan*~deteraid*~value	1	0.257989

Pathway 2: ~finmanage*~procurement*~floorplan*~location*~value

Subset	Consistency	Coverage
~finmanage*~floorplan*~value	0.924205	0.348927
~procurement*~floorplan*~value	0.953428	0.269042
~finmanage*~procurement*~floorplan*~value	0.953428	0.269042
~location*~value	0.918188	0.147494
~floorplan*~location*~value	0.918188	0.147494
~finmanage*~location*~value	0.918188	0.147494
~procurement*~location*~value	0.918188	0.147494
~finmanage*~floorplan*~location*~value	0.918188	0.147494
~finmanage*~procurement*~location*~value	0.918188	0.147494
~procurement*~floorplan*~location*~value	0.918188	0.147494

~finmanage*~procurement*~floorplan*~location*~value	0.918188	0.147494

Pathway 3: ~oversight*procurement*~sweatequity*~govpermit*~value

Subset	Consistency	Coverage
~oversight*procurement	1	0.064161
~oversight*procurement*~value	1	0.064161
~oversight*procurement*~govpermit	1	0.064161
procurement*~sweatequity*~govpermit	1	0.061412
~oversight*procurement*~sweatequity	1	0.061412
~oversight*procurement*~govpermit*~value	1	0.064161
procurement*~sweatequity*~govpermit*~value	1	0.061412
~oversight*procurement*~sweatequity*~value	1	0.061412
~oversight*procurement*~sweatequity*~govpermit	1	0.061412
~oversight*procurement*~sweatequity*~govpermit*~value	1	0.061412

Pathway 4: ~finmanage*~procurement*sweatequity*~floorplan*~location

Subset	Consistency	Coverage
sweatequity	0.847861	0.490376
~finmanage*sweatequity	0.890467	0.402383
sweatequity*~floorplan	0.857143	0.417965
~procurement*sweatequity	0.851703	0.389551
~finmanage*sweatequity*~floorplan	0.883369	0.374885
~finmanage*~procurement*sweatequity	0.883369	0.374885
~procurement*sweatequity*~floorplan	0.875289	0.347388
~finmanage*~procurement*sweatequity*~floorplan	0.875289	0.347388
sweatequity*~location	0.826667	0.227314
sweatequity*~floorplan*~location	0.826667	0.227314
~finmanage*sweatequity*~location	0.826667	0.227314
~procurement*sweatequity*~location	0.826667	0.227314
~finmanage*sweatequity*~floorplan*~location	0.826667	0.227314
~procurement*sweatequity*~floorplan*~location	0.826667	0.227314
~finmanage*~procurement*sweatequity*~location	0.826667	0.227314
~finmanage*~procurement*sweatequity*~floorplan*~location	0.826667	0.227314

Pathway 5: ~oversight*~finmanage*~procurement*~sweatequity*~floorplan*location

Subset	Consistency	Coverage
~oversight*~finmanage*~sweatequity	1	0.180568
~procurement*~sweatequity*~floorplan*location	1	0.183318
~finmanage*~procurement*~sweatequity*~floorplan*location	1	0.183318
~oversight*~finmanage*~sweatequity*location	1	0.180568
~oversight*~finmanage*~procurement*~sweatequity	1	0.180568
~oversight*~finmanage*~procurement*~sweatequity*location	1	0.180568
~oversight*~sweatequity*~floorplan	1	0.153071
~oversight*~sweatequity*~floorplan*location	1	0.153071
~oversight*~finmanage*~sweatequity*~floorplan	1	0.153071
~oversight*~procurement*~sweatequity*~floorplan	1	0.153071
~oversight*~finmanage*~sweatequity*~floorplan*location	1	0.153071
~oversight*~procurement*~sweatequity*~floorplan*location	1	0.153071
~oversight*~finmanage*~procurement*~sweatequity*~floorplan	1	0.153071
~oversight*~finmanage*~procurement*~sweatequity*~floorplan*location	1	0.153071

Pathway 6: ~oversight*~finmanage*~procurement*~govpermit*~floorplan*~deteraid*location

Subset	Consistency	Coverage
~deteraid	0.846552	0.450046
~floorplan*~deteraid	0.875686	0.439047
~floorplan*location	0.809187	0.419798
~finmanage*~deteraid	0.877083	0.385885
~finmanage*~floorplan*~deteraid	0.877083	0.385885
~finmanage*~floorplan*location	0.814255	0.345555
~deteraid*location	0.806522	0.340055
~floorplan*~deteraid*location	0.840749	0.329056
~oversight*~finmanage	0.897059	0.279560
~oversight*~finmanage*~procurement	0.897059	0.279560
~finmanage*~deteraid*location	0.836111	0.275894
~finmanage*~floorplan*~deteraid*location	0.836111	0.275894
~procurement*~deteraid	0.845714	0.271311
~procurement*~floorplan*~deteraid	0.845714	0.271311
~finmanage*~procurement*~deteraid	0.845714	0.271311
~finmanage*~procurement*~floorplan*~deteraid	0.845714	0.271311
~oversight*~floorplan	0.885993	0.249313
~oversight*~finmanage*~floorplan	0.885993	0.249313
~oversight*~procurement*~floorplan	0.885993	0.249313
~oversight*~finmanage*~procurement*~floorplan	0.885993	0.249313
~procurement*~floorplan*location	0.820000	0.225481
~finmanage*~procurement*~floorplan*location	0.820000	0.225481
~oversight*~finmanage*location	0.870370	0.215399
~oversight*~finmanage*~procurement*location	0.870370	0.215399
~oversight*~floorplan*location	0.852321	0.185151
~oversight*~finmanage*~floorplan*location	0.852321	0.185151
~oversight*~procurement*~floorplan*location	0.852321	0.185151
~oversight*~finmanage*~procurement*~floorplan*location	0.852321	0.185151
~oversight*~deteraid	0.847826	0.178735
~oversight*~finmanage*~deteraid	0.847826	0.178735
~oversight*~floorplan*~deteraid	0.847826	0.178735
~oversight*~procurement*~deteraid	0.847826	0.178735
~oversight*~finmanage*~floorplan*~deteraid	0.847826	0.178735
~oversight*~procurement*~floorplan*~deteraid	0.847826	0.178735
~oversight*~finmanage*~procurement*~deteraid	0.847826	0.178735
~oversight*~finmanage*~procurement*~floorplan*~deteraid	0.847826	0.178735
~oversight*~deteraid*location	0.825000	0.151237
~oversight*~finmanage*~deteraid*location	0.825000	0.151237
~oversight*~floorplan*~deteraid*location	0.825000	0.151237
~oversight*~procurement*~deteraid*location	0.825000	0.151237
~oversight*~finmanage*~floorplan*~deteraid*location	0.825000	0.151237
~oversight*~procurement*~floorplan*~deteraid*location	0.825000	0.151237
~oversight*~finmanage*~procurement*~deteraid*location	0.825000	0.151237
~oversight*~finmanage*~procurement*~floorplan*~deteraid*location	0.825000	0.151237

From the subsets we can remove location selection, government permitting, and procurement. None of these appear in any of the subsets observed, except procurement, however for the single case covered by pathway 3, procurement does not provide explanation for the lack of household savings.

Revised Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
~finmanage*~floorplan*~value	0.348927	0.111775	0.924205	Tagpuro, Cogon, Kangkaibe
~oversight*~finmanage*~floorplan	0.249313	0.063473	0.885993	San Agustin, Pago, Bagacay (93), Okoy
~finmanage*sweatequity*~floorplan	0.374885	0.149503	0.883369	Maricaban, Poblacion, Pago, San Agustin
~sweatequity*~floorplan*~deteraid*~value	0.257989	0.047103	1.000000	Cantahay, Kangkaibe

solution coverage: 0.700724

solution consistency: 0.866072

While the subset/superset analysis was able to remove some conditions, the solution still remains relatively complex. Notably however, we see similar conditions that were observed in the pathways to the presence of household savings. The absence of financial management is central in 3 of the pathways, aligning with what we would expect to see when financial decisions are externally controlled.

Social Capital

I begin by examining the necessity and sufficiency of individual condition on the outcome of social capital. A summary of the conditions is presented in Table F-12 below. For financial management, I do not make a simplifying assumption as there is not strong theory to support a directional relationship, and in some cases arguments could be made that both the presence and absence of this condition may establish separate pathways.

For all the remaining conditions, I assumed that their presence would result in the presence of social capital. High value of aid is likely to lead to more resources and thus establish social ties more quickly. There is substantive knowledge to support that location selection will lead to closer social ties within communities where households are able to select the site of their shelter. We would expect the presence of floorplan and layout to lead to the present of social capital as this process may involve linking capital between community leaders and households. Similarly, government permitting may enhance linking capital. Sweat equity is anticipated to lead to stronger bonding and bridging capital between households, thus the reason I assume that it should be present. Procurement may also lead to higher bridging capital outside of immediate social groups. Lastly, oversight may create cohesion through joint goals, particularly as this was observed through clustering of households.

Table F-12: Necessity and Sufficiency of Social Capital Outcome

Presence of Condition	Necessity	Coverage
Determination of Aid	0.793996	0.581061
Location Selection	0.758799	0.563846
~Financial Management	0.714286	0.534884
Oversight	0.71118	0.520455
Value of Aid	0.662628	0.664243
Government Permitting	0.621118	0.428571
Floorplan and Layout	0.55176	0.726158
Sweat Equity	0.412008	0.630745
Financial Management	0.347826	0.55082
Procurement	0.241201	0.388333

Assumptions:

- Oversight (present)
- Financial Management (present or absent)
- Procurement (present)
- Sweat Equity (present)
- Government permitting (present)
- Floorplan and Layout (present)
- Determination of Aid (present)
- Location Selection (present)
- Value (present)

Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
~finmanage*sweatequity*location*value	0.166667	0.132505	1.000000	San Agustin
~finmanage*govpermit*deteraid*location*value	0.199793	0.165631	0.950262	Sagkahan (62), Okoy, San Jose (83C)
oversight*finmanage*~procurement*floorplan*deteraid*location	0.072464	0.072464	1.000000	New Kawayan (101)

solution coverage: 0.404762

solution consistency: 0.975062

Subset/Superset Analysis

In order to examine ways to reduce the complexity of the above pathways, I examine subsets of the outcomes, in this case, the absence of household savings. A list of subsets for the 3 pathways are shown below. Combinations of conditions are listed for all subsets higher than the original pathway, if such subsets exist. If such a subset does not exist, then up to 5 subsets greater than the consistency cutoff value of 0.8, are listed.

Pathway 1: ~finmanage*sweatequity*location*value

Subset	Consistency	Coverage
~finmanage*sweatequity*location	1	0.199793
~finmanage*sweatequity*location*value	1	0.166667
sweatequity*location*value	0.910714	0.21118
sweatequity*location	0.900302	0.308489
~finmanage*location*value	0.841981	0.369565
location*value	0.805195	0.449275

Pathway 2: ~finmanage*govpermit*deteraid*location*value

Subset	Consistency	Coverage
~finmanage*deteraid*location*value	0.951776	0.206729
~finmanage*govpermit*deteraid*location*value	0.950262	0.200117

Pathway 3: oversight*finmanage*~procurement*floorplan*deteraid*location

Subset	Consistency	Coverage
oversight*finmanage*~procurement	1	0.072464
oversight*~procurement*floorplan	1	0.203934
oversight*~procurement*floorplan*location	1	0.203934
oversight*finmanage*~procurement*location	1	0.072464
oversight*finmanage*~procurement*deteraid	1	0.072464
oversight*~procurement*floorplan*deteraid	1	0.203934
oversight*finmanage*~procurement*floorplan	1	0.072464
oversight*finmanage*~procurement*deteraid*location	1	0.072464
oversight*~procurement*floorplan*deteraid*location	1	0.203934
oversight*finmanage*~procurement*floorplan*location	1	0.072464
oversight*finmanage*~procurement*floorplan*deteraid	1	0.072464
oversight*finmanage*~procurement*floorplan*deteraid*location	1	0.072464

Based on my analysis, several conditions can be removed from the analysis. Notably, the absence of financial management has low necessity and from case knowledge, there is little evidence to support to a strong link to social capital. Government permitting does not appear in any of the subsets of pathways and can thus be removed. Further, floorplan and layout, procurement, and oversight do not appear in subsets of the pathways and can be removed to create greater parsimony.

Revised Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
sweatequity*value*location	0.21118	0.13147	0.910714	San Agustin
deteraid*value*location	0.283644	0.203934	0.892508	Sagkahan (62), Sulangan, Okoy, San Jose (83C)

solution coverage: 0.415114
solution consistency: 0.923963

From the revised solution, I can see excellent parsimony in the two pathways. Despite this, I still observe a relatively low solution coverage, meaning that many of the cases with a social capital outcome are not covered. This may in part be explained by pre-existing factors that influence social capital and long term commitments needed to enhance this vital community outcome.

Absence of Social Capital

Similar to the outcome of household savings, I made the inverse assumptions for the selected conditions when considering the absence of social capital. I first investigate necessity and sufficiency of individual conditions. A summary of this analysis can be found in Table F-13 below.

Table F-13: Necessity and Sufficiency of Absence of Social Capital Outcome

Presence of Condition	Necessity	Coverage
Value of Aid	0.691368	0.670095
Determination of Aid	0.605996	0.435385
Financial Management	0.249465	0.381967
~Value of Aid	0.588689	0.587212
~Location Selection	0.394004	0.613333
~Determination of Aid	0.307281	0.494828
~Floorplan and Layout	0.750535	0.601201
~Government Permitting	0.249465	0.466000
~Sweat Equity	0.714133	0.525611
~Procurement	0.822270	0.590769
~Financial Management	0.814775	0.589922
~Oversight	0.396146	0.637931

Assumptions:

- Oversight (absent)
- Financial Management (present or absent)
- Procurement (absent)
- Sweat Equity (absent)
- Government permitting (absent)
- Floorplan and Layout (absent)
- Determination of Aid (present or absent)
- Location Selection (absent)
- Value (present or absent)

Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
~sweatequity*~floorplan*~deteraid*~value	0.266023	0.126126	0.882757	Cantahay, Kangkaibe
finmanage*procurement*~sweatequity*deteraid* ~value	0.159252	0.143469	1.000000	San Jose (85), Magallanes (52)
~oversight*~finmanage*~procurement* ~sweatequity*~floorplan*~deteraid	0.103854	0.043980	0.74615	Bagacay (93)
~finmanage*~procurement*~sweatequity* ~floorplan*deteraid*~location	0.178801	0.114561	0.695833	Sillon, Tagpuro, Cogon
~oversight*~finmanage*~procurement* ~floorplan*deteraid*~location*value	0.071734	0.071734	0.957143	Pago

solution coverage: 0.639768

solution consistency: 0.845728

Subset/Superset Analysis

In order to examine ways to reduce the complexity of the above pathways, I examine subsets of the outcomes, in this case, the absence of household savings. A list of subsets for the 5 pathways are shown below. Combinations of conditions are listed for all subsets higher than the original pathway, if such subsets exist. If such a subset does not exist, then up to 5 subsets greater than the consistency cutoff value of 0.8, are listed.

Pathway 1: ~sweatequity*~floorplan*~deteraid*~value

Subset		Consistency	Coverage
~sweatequity*~deteraid*~value		0.882757	0.266023
~sweatequity*~floorplan*~deteraid*~value		0.882757	0.266023

Pathway 2: finmanage*procurement*~sweatequity*deteraid*~value

Subset	Consistency	Coverage
procurement*~sweatequity*~value	1	0.309877
finmanage*procurement*~sweatequity*~value	1	0.230610
procurement*~sweatequity*deteraid*~value	1	0.183751
finmanage*procurement*~sweatequity*deteraid*~value	1	0.159252

Pathway 3: ~oversight*~finmanage*~procurement*~sweatequity*~floorplan*~deteraid

Subset	Consistency	Coverage
~sweatequity*~deteraid	0.829457	0.343683
~sweatequity*~floorplan*~deteraid	0.829457	0.343683
~procurement*~sweatequity*~deteraid	0.826316	0.168094
~procurement*~sweatequity*~floorplan*~deteraid	0.826316	0.168094
~finmanage*~procurement*~sweatequity*~deteraid	0.826316	0.168094
~finmanage*~procurement*~sweatequity*~floorplan*~deteraid	0.826316	0.168094

Pathway 4: ~finmanage*~procurement*~sweatequity*~floorplan*deteraid*~location

Subset	Consistency	Coverage
~floorplan*deteraid	0.739323	0.537473
~finmanage*~floorplan*deteraid	0.711256	0.466809
deteraid*~location	0.702083	0.360814
~sweatequity*~floorplan*deteraid	0.756264	0.355460
~finmanage*~sweatequity*~floorplan*deteraid	0.713137	0.284797

Pathway 5: ~oversight*~finmanage*~procurement*~floorplan*deteraid*~location*value

Subset	Consistency	Coverage
~oversight*~location	0.957143	0.071734
~oversight*~location*value	0.957143	0.071734
~oversight*deteraid*~location	0.957143	0.071734
~oversight*~floorplan*~location	0.957143	0.071734
~oversight*~finmanage*~location	0.957143	0.071734
~oversight*~procurement*~location	0.957143	0.071734
~oversight*deteraid*~location*value	0.957143	0.071734
~oversight*~finmanage*~location*value	0.957143	0.071734
~oversight*~floorplan*~location*value	0.957143	0.071734
~oversight*~procurement*~location*value	0.957143	0.071734
~oversight*~floorplan*deteraid*~location	0.957143	0.071734
~oversight*~finmanage*deteraid*~location	0.957143	0.071734
~oversight*~finmanage*~floorplan*~location	0.957143	0.071734
~oversight*~procurement*deteraid*~location	0.957143	0.071734
~oversight*~procurement*~floorplan*~location	0.957143	0.071734
~oversight*~finmanage*~procurement*~location	0.957143	0.071734
~oversight*~finmanage*deteraid*~location*value	0.957143	0.071734
~oversight*~floorplan*deteraid*~location*value	0.957143	0.071734
~oversight*~procurement*deteraid*~location*value	0.957143	0.071734
~oversight*~finmanage*~floorplan*~location*value	0.957143	0.071734
~oversight*~finmanage*~procurement*~location*value	0.957143	0.071734
~oversight*~procurement*~floorplan*~location*value	0.957143	0.071734

~oversight*~finmanage*~floorplan*deteraid*~location	0.957143	0.071734
~oversight*~procurement*~floorplan*deteraid*~location	0.957143	0.071734
~oversight*~finmanage*~procurement*deteraid*~location	0.957143	0.071734
~oversight*~finmanage*~procurement*~floorplan*~location	0.957143	0.071734
~oversight*~finmanage*~floorplan*deteraid*~location*value	0.957143	0.071734
~oversight*~procurement*~floorplan*deteraid*~location*value	0.957143	0.071734
~oversight*~finmanage*~procurement*deteraid*~location*value	0.957143	0.071734
~oversight*~finmanage*~procurement*~floorplan*~location*value	0.957143	0.071734
~oversight*~finmanage*~procurement*~floorplan*deteraid*~location	0.957143	0.071734
~oversight*~finmanage*~procurement*~floorplan*deteraid*~location*value	0.957143	0.071734

In examining the subsets, neither floorplan and layout nor government permitting appear in more parsimonious set, therefore I remove them from the analysis.

Revised Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
~value*procurement*~sweatequity	0.309877	0.309877	1	Magallanes (52), San Jose (85), Cantahay, Kangkaibe
~location*~procurement*deteraid*~sweatequity	0.178801	0.178801	0.695833	Sillon, Tagpuro, Cogon
~location*~oversight*value*~procurement* deteraid	0.071734	0.071734	0.957143	Pago

solution coverage: 0.560412

solution consistency: 0.873212

From the revised solution we see slightly more parsimonious solutions, but they still remain complex. This is again likely in part due to engrained social norms within communities, reflecting the difficultly in connecting participation to social capital, or in this case its absence.

Training Analysis

The truth table for the analysis is provided below in Table F-14. A summary of the condition and outcome calibrations can be found in Appendix E. The pathways for the outcome of interest, construction knowledge, are discussed in Chapter 4.

I considered six conditions in initial analysis. A consistency cutoff of 0.8 was used, while also considering PRI values of pathways. While no specific cutoff was used for PRI, pathways with large gaps between raw consistency and PRI values were removed. Through subset/superset analysis conditions were then removed in order to achieve more parsimonious solutions.

Table F-14: Training Truth Table

Case	Community	observations	formal	train_ce	train_ro	train_ac	train_ae	constknow
1	Okoy	0	1	1	1	1	1	0.56
2	Maricaban	1	0	1	1	0	1	0.94
3	Poblacion	0	0	1	1	0	1	0.34
4	Sungko	1	1	1	1	0	1	0.99
5	Sillon	0	0	0	0	0	0	0.07
6	Kangkaibe	1	0	1	1	0	1	0.98
7	Tagpuro	0	0	0	0	0	0	0.17
8	Pago	0	1	1	1	1	1	0.53
9	New Kawayan (101)	0	1	0	1	1	0	0.03
10	Bagacay (93)	1	1	1	1	1	1	0.88
11	San Agustin	1	1	1	1	0	1	1.00
12	San Jose (83C)	1	0	0	1	0	0	0.86
13	Magallanes (52)	0	1	1	1	1	1	0.09
14	San Jose (85)	1	1	1	1	1	1	0.9
15	Hiabangan	0	1	1	1	0	1	0.94
16	Sagkahan (62)	0	1	0	1	1	0	0.41
17	Sulangan	1	1	1	1	1	1	0.17
18	Cogon	0	0	0	0	0	0	0.59
19	Cantahay	1	1	1	1	1	1	0.89

Simplifying Assumptions

In order to achieve parsimony in the solutions created, I have drawn on 'easy counterfactuals' to reduce complexity, similar to the previous analysis of participation (Ragin and Sonnett 2005). A summary of simplifying assumptions for all conditions are presented in Table F-15 below.

Table F-15: Summary of Simplifying Assumptions for Training

	Construction Knowledge
On-Site Observations	Present
Formal Training	Present
Concrete Experience	Present
Reflective Observation	Present
Abstract Conceptualization	Present
Active Experimentation	Present

Construction Knowledge

As a preliminary step, I first investigate the necessity and coverage of individual conditions on construction knowledge. The results of this initial analysis are shown in Table F-16 below. The presence of all conditions is expected to lead to construction knowledge.

I expect that the presence of each individual condition will lead to greater access to knowledge, thus potentially lead to higher knowledge acquisition. Further, my interview data suggests that both formal training and on-site experiences should result in the presence of higher construction knowledge.

Table F-16: Necessity and Sufficiency of Construction Knowledge Outcome

Condition	Necessity	Coverage
Reflective Observation	0.926808	0.656875
Concrete Experience	0.812169	0.708462
Active Experimentation	0.812169	0.708462
On-Site Observations	0.671076	0.845556
Formal Training	0.651675	0.615833
Abstract Conceptualization	0.393298	0.495556

Assumptions:

- Concrete Experience (present)
- Reflective Observation (present)
- Active Experimentation (present)
- Abstract Conceptualization (present)
- On-Site Observations (present)
- Formal Training (present)

Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
~train_ac*train_ro*observations	0.420635	0.245150	0.954000	Maricaban, Sungko, Kangkaibe, San Agustin, San Jose (83C)
train_ae*~train_ac*train_ro*train_ce*formal	0.258377	0.082892	0.976667	Sungko, San Agustin, Hiabangan

solution coverage: 0.503527

solution consistency: 0.951667

Subset/Superset Analysis

In order to potentially reduce the complexity of the solution obtained, I next investigate each of the pathways obtained in the initial intermediate solution to determine if there are simpler pathways which maintain the same level of consistency, but potentially greater coverage. The 2 pathways from the construction knowledge solution are listed below. Combinations of conditions are listed for all subsets higher than the original pathway, if such subsets exist. If such a subset does not exist, then up to 5 subsets greater than the consistency cutoff value of 0.8, are listed.

Pathway 1: ~train_ac*train_ro*observations

Subset	Consistency	Coverage
~train_ac*observations	0.954000	0.420635
~train_ac*train_ro*observations	0.954000	0.420635

Pathway 2: train_ae*~train_ac*train_ro*train_ce*formal

Subset	Consistency	Coverage
train_ae*~train_ac*train_ro*train_ce	0.865000	0.457672
~train_ac*train_ro*train_ce*formal	0.976667	0.258377
train_ae*~train_ac*train_ce*formal	0.976667	0.258377
train_ae*~train_ac*train_ro*formal	0.976667	0.258377
train_ae*~train_ac*train_ro*train_ce*formal	0.976667	0.258377

My analysis of subsets shows that I cannot remove any of the training formats as they all appear in both of the pathways. In the case of abstract conceptualization formats, this happens to be the absence of the condition. While we could consider removing formal training, the consistency of the pathways is slightly decreased by its removal, thus we leave it in the analysis. As a result, there is no need to revise the previous analysis.

Resilience and Sustainability Analysis

The truth table for the analysis is provided below in Table F-18. A summary of the condition and outcome calibrations can be found in Appendix E. The pathways for the outcomes of interest, resilience and sustainability of infrastructure systems, are discussed in Chapter 5.

We considered six conditions in initial analysis. A consistency cutoff of 0.8 was used, while also considering PRI values of pathways. While no specific cutoff was used for PRI, pathways with large gaps between raw consistency and PRI values were removed. Through subset/superset analysis conditions were then removed in order to achieve more parsimonious solutions.

Simplifying Assumptions

Part of QCA relies on making Boolean minimization, drawing from relevant theoretical and substantive knowledge in order to resolve counterfactuals. In order to achieve parsimony in the solutions created, we have drawn on 'easy counterfactuals' to reduce complexity (Ragin and Sonnett 2005). While often neglected, simplifying assumptions constitute an important step in the QCA process. For the outcome, we have included a discussion of assumptions made, drawing on theoretical and case knowledge used to inform these decisions. A summary of simplifying assumptions for all conditions are presented in Table F-17 below.

Table F-17: Summary of Simplifying Assumptions for Resilience and Sustainability

	Resilience	**Sustainability**
Planning Coordination	Present	Present
Planning Participation	Present	Present
Design Coordination	Present	Present
Design Participation	Present	Present
Construction Participation	Present	Present
Construction Training	Present	Present

Table F-18: Resilience and Sustainability Truth Table

Case	Community	PlanCoord	PlanPart	DesCoord	DesPart	ConstPart	ConstTrain	Resilience	Sustain	Combined
1	Okoy	0.78	0.70	0.67	0.67	0.17	1.00	0.59	0.70	0.59
2	Maricaban	0.68	0.00	0.33	0.00	0.50	0.50	0.36	0.60	0.36
3	Poblacion	0.44	0.00	0.00	0.00	0.50	0.00	0.46	0.22	0.22
4	Sungko	0.11	1.00	0.00	0.00	0.35	0.00	0.47	0.45	0.45
5	Sillon	0.44	0.00	0.33	0.00	0.50	0.00	0.35	0.37	0.35
6	Kangkaibe	1.00	0.00	0.33	0.00	0.50	0.50	0.39	0.67	0.39
7	Tagpuro	0.44	0.00	0.33	0.00	0.50	0.00	0.40	0.21	0.21
8	Pago	0.46	0.00	0.33	0.00	0.50	0.50	0.29	0.37	0.29
9	New Kawayan (101)	0.22	1.00	0.00	0.00	0.85	0.84	0.69	0.73	0.69
10	Bagacay (93)	0.78	0.00	0.33	0.00	0.17	1.00	0.43	0.69	0.43
11	San Agustin	0.22	0.00	0.33	0.00	0.34	0.34	0.39	0.27	0.27
12	San Jose (83C)	0.78	1.00	0.33	0.67	0.50	0.50	0.68	0.85	0.68
13	Magallanes (52)	1.00	1.00	1.00	0.67	1.00	0.50	0.42	0.45	0.42
14	San Jose (85)	0.57	1.00	0.00	0.00	0.67	1.00	0.42	0.65	0.42
15	Hiabangan	0.68	1.00	0.00	0.00	0.50	0.84	0.72	0.75	0.72
16	Sagkahan (62)	1.00	1.00	1.00	0.67	0.50	0.67	0.73	0.88	0.73
17	Sulangan	0.78	0.70	1.00	0.67	1.00	1.00	0.58	0.59	0.58
18	Cogon	0.56	0.00	0.33	0.00	0.50	0.00	0.50	0.42	0.42
19	Cantahay	0.67	0.00	0.00	0.33	0.85	1.00	0.30	0.38	0.30

Resilience

As a preliminary step, we first investigate the necessity and coverage of individual conditions on resilience. The results of this initial analysis are shown in Table F-19 below. The presence of all conditions is expected to lead to resilience. We expect that the presence of each individual condition will result in more efficient project management processes and resilience.

Table F-19: Necessity and Sufficiency of Resilience Outcome

Condition	Necessity	Coverage
Planning Coordination	0.883446	0.699714
Construction Participation	0.836466	0.740158
Construction Training	0.729754	0.659066
Planning Participation	0.577806	0.631796
Design Coordination	0.571089	0.789969
Design Participation	0.351351	0.878129

Assumptions:

- Planning Coordination (present)
- Planning Participation (present)
- Design Coordination (present)
- Design Participation (present)
- Construction Participation (present)
- Construction Training (present)

Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
consttrain*constpart*planpart	0.412214	0.194111	0.863014	New Kawayan (101), Sulangan
consttrain*despart*descoord*planpart*plancoord	0.282443	0.064340	0.911972	Okoy, Sagkahan, Sulangan

solution coverage: 0.476554

solution consistency: 0.865347

Subset/Superset Analysis

In order to potentially reduce the complexity of the solution obtained, we next investigate each of the pathways obtained in the initial intermediate solution to determine if there are simpler pathways which maintain the same level of consistency, but potentially greater coverage. The two pathways from the resilience solution are listed below. Combinations of conditions are listed for all subsets higher than the original pathway, if such subsets exist. If such a subset does not exist, then up to five subsets greater than the consistency cutoff value of 0.8, are listed.

Pathway 1: consttrain*constpart*planpart

Subset	Consistency	Coverage
consttrain*constpart*planpart	0.863014	0.412214

Pathway 2: consttrain*despart*descoord*planpart*plancoord

Subset	Consistency	Coverage
consttrain*despart*planpart	0.916943	0.300981
consttrain*despart*planpart*plancoord	0.916943	0.300981
consttrain*despart	0.916168	0.333697
consttrain*despart*plancoord	0.916168	0.333697
consttrain*despart*descoord	0.911972	0.282443
consttrain*despart*descoord*planpart	0.911972	0.282443
consttrain*despart*descoord*plancoord	0.911972	0.282443
consttrain*despart*descoord*planpart*plancoord	0.911972	0.282443
consttrain*descoord*plancoord	0.910913	0.446020

From the subset/superset analysis as well as the earlier necessity and sufficiency analysis, we can remove design participation and maintain the same level of consistency. We thus remove this condition from the analysis.

Revised Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
consttrain*constpart*planpart	0.412214	0.194111	0.863014	New Kawayan (101), Sulangan
consttrain*descoord*planpart*plancoord	0.282443	0.064340	0.902439	Okoy, Sagkahan, Sulangan

solution coverage: 0.476554

solution consistency: 0.865347

From the revised analysis, two cases fall into the first pathway and three fall into the second, with one of these cases overlapping.

Sustainability

As a preliminary step, we first investigate the necessity and coverage of individual conditions. The results of this initial analysis are shown in Table F-20 below. The presence of all conditions is expected to sustainability.

Table F-20: Necessity and Sufficiency of Sustainability Outcome

Condition	Necessity	Coverage
Planning Coordination	0.890482	0.785283
Construction Participation	0.765156	0.753854
Construction Training	0.755867	0.760079
Planning Participation	0.590450	0.718849
Design Coordination	0.525098	0.808735
Design Participation	0.330020	0.918367

Assumptions:

- Planning Coordination (present)
- Planning Participation (present)
- Design Coordination (present)
- Design Participation (present)
- Construction Participation (present)
- Construction Training (present)

Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
consttrain*~constpart*plancoord	0.498537	0.288780	0.951583	Okoy, Bagacay (93)
consttrain*constpart*planpart	0.399024	0.189268	0.93379	New Kawayan (101), Sulangan, San Jose (85)

solution coverage: 0.687805

solution consistency: 0.927362

Subset/Superset Analysis

In order to potentially reduce the complexity of the solution obtained, we next investigate each of the pathways obtained in the initial intermediate solution to determine if there are simpler pathways which maintain the same level of consistency, but potentially greater coverage. The two pathways from the sustainability solution are listed below. Combinations of conditions are listed for all subsets higher than the original pathway, if such subsets exist. If such a subset does not exist, then up to five subsets greater than the consistency cutoff value of 0.8, are listed.

Pathway 1: consttrain*~constpart*plancoord

Subset	Consistency	Coverage
consttrain*~constpart*plancoord	0.951583	0.498537
consttrain*~constpart	0.916519	0.503415

Pathway 2: consttrain*constpart*planpart

Subset	Consistency	Coverage
consttrain*constpart*planpart	0.93379	0.399024

Despite similar consistency and coverage of the both combinations of conditions in pathway 1, the presence of planning coordination provides strong explanatory power for the cases. We could also remove both conditions during the design phase, design coordination and design participation, however analysis after removing these conditions does not have an impact on the final pathways. As a result, there is no need to revise the initial pathways determined.

Combined Resilience and Sustainability

In order to analyze the combined outcome of resilience and sustainability, we assign the minimum value of the two individual outcomes. Practically, the lower value limits the presence of the combined outcome. For example, in case 1, the community of Okoy had a resilience set value of 0.59 and a sustainability set value of 0.70, thus the 0.59 becomes the combined set value. Across all of the cases examined, there were no cases where resilience was present without the presence of sustainability – in particular, six cases exhibited the combined outcome.

As a preliminary step, we again first investigate the necessity and coverage of individual conditions. The results of this initial analysis are shown in Table F-20 below. The presence of all conditions is expected to sustainability.

Table F-21: Necessity and Sufficiency of Combined Resilience and Sustainability Outcome

Condition	Necessity	Coverage
Planning Coordination	0.893587	0.656762
Construction Participation	0.833064	0.684046
Construction Training	0.778191	0.652184
Planning Participation	0.620299	0.629399
Design Coordination	0.593717	0.762107
Design Participation	0.378627	0.878129

Assumptions:

- Planning Coordination (present)
- Planning Participation (present)
- Design Coordination (present)
- Design Participation (present)
- Construction Participation (present)
- Construction Training (present)

Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
consttrain*constpart*planpart	0.412214	0.194111	0.863014	New Kawayan (101), Sulangan
consttrain*despart*descoord*planpart*plancoord	0.282443	0.064340	0.911972	Okoy, Sagkahan, Sulangan

solution coverage: 0.514723

solution consistency: 0.865347

Subset/Superset Analysis

In order to potentially reduce the complexity of the solution obtained, we next investigate each of the pathways obtained in the initial intermediate solution to determine if there are simpler pathways which maintain the same level of consistency, but potentially greater coverage. The two pathways from the combined solution are listed below. Combinations of conditions are listed for all subsets higher than the original pathway, if such subsets exist. If such a subset does not exist, then up to five subsets greater than the consistency cutoff value of 0.8, are listed.

Pathway 1: consttrain*constpart*planpart

Subset	Consistency	Coverage
consttrain*constpart*planpart	0.863014	0.44523

Pathway 2: consttrain*despart*descoord*planpart*plancoord

Subset	Consistency	Coverage
consttrain*despart*planpart	0.916943	0.325088
consttrain*despart*planpart*plancoord	0.916943	0.325088
consttrain*despart	0.916168	0.360424
consttrain*despart*plancoord	0.916168	0.360424
consttrain*despart*descoord	0.911972	0.305065
consttrain*despart*descoord*planpart	0.911972	0.305065
consttrain*despart*descoord*plancoord	0.911972	0.305065
consttrain*despart*descoord*planpart*plancoord	0.911972	0.305065
consttrain*descoord*plancoord	0.910913	0.481743

Similar to the standalone resilience outcomes, my analysis reveals that design participation can be removed as it does not appear in more parsimonious pathways.

Intermediate Solution

Pathway	Raw Coverage	Unique Coverage	Consistency	Cases
consttrain*constpart*planpart	0.445230	0.209658	0.863014	New Kawayan (101), Sulangan
consttrain*descoord*planpart*plancoord	0.305065	0.069494	0.902439	Okoy, Sagkahan, Sulangan

solution coverage: 0.514723

solution consistency: 0.865347

APPENDIX G FOUNDATIONAL PUBLICATIONS

In developing the research presented in this dissertation, there were several complementary studies conducted that provided served as a foundation to build upon. In particular, the first journal article below outlined the need for the broader scope of research conducted in this dissertation. It was further used to compile resilience indicators which were used to structure the outcome assessment for Chapter 5. In the next two articles, inter-organizational networks and authority with coordination practice were explored, laying the foundation for Chapter 2. The fourth journal article was a pilot to explore training methods in three of the nineteen communities, expanded upon in Chapter 4.

Opdyke, A., Javernick-Will, A., and Koschmann, M. (2017) "Infrastructure Hazard Resilience Trends: An Analysis of 25 Years of Research" Natural Hazards. 87 (2), 773-789. DOI: 10.1007/s11069-017-2792-8

Abstract: Hazard research has made significant strides over the last several decades, answering critical questions surrounding vulnerability and recovery. Recently, resilience has come to the forefront of scholarly debates and practitioner strategies, yet there remain challenges implementing resilience in practice, the result of a complex web of research that spread across numerous fields of study. As a result, there is a need to analyze and reflect on the current state of resilience literature. We reviewed 241 journal articles from the Web of Science and Engineering Village databases from 1990 to 2015 to analyze research trends in geographic location of studies, methods employed, units of analysis, and resilience dimensions studied, as well as correlations between each of these categories. The majority of the studies analyzed were conducted in North America, used quantitative methods, focused on infrastructure and community units of analysis, and studied governance, infrastructure, and economic dimensions of resilience. This analysis points to the need to: (1) conduct studies in developing country contexts, where resilience is particularly important; (2) employ mixed-methods for additional depth to quantitative studies; (3) connect units of analysis, such as infrastructure and community; and (4) expand on the measurement and study of environmental and social dimensions of resilience.

Opdyke, A., Leprore, F., Javernick-Will, A., and Koschmann, M. (2016) "Inter-Organizational Resource Coordination in Post-Disaster Infrastructure Recovery" Construction Management and Economics. 35 (8-9), 514-530. DOI: 10.1080/01446193.2016.1247973

Abstract: Despite significant advances in strengthening post-disaster recovery efforts, misaligned strategy and inefficient resource allocation are far too often the norm for infrastructure reconstruction. To examine the inter-organizational networks that form to coordinate resources for infrastructure reconstruction, we employed social network analysis in 19 communities in the Philippines following Super Typhoon Haiyan, at 6 and 12 months' post-disaster. To build these networks, we analysed interview, field observation and documentation data collected from non-governmental organizations, local governments and communities. A survey questionnaire was also administered to organizations working in selected communities to validate networks. Results from network analysis established that information was the most commonly shared resource by organizations, followed by financial, material and human resources. Government agencies had the highest actor centralities; however, qualitative data suggest that these roles were the result of obligatory consultations by international organizations and lacked legitimacy in practice. Findings further demonstrate that networks become more decentralized over time as actors leave and roles become more established, influenced by short-term expatriate contracts and the termination of United Nations supported cluster coordination. Findings could help organizations strengthen humanitarian response efforts by attending to resource allocation and knowledge sharing with other organizations.

Koschmann, M., Kopczynski, J., Opdyke, A., and Javernick-Will, A. (2017) "Constructing Authority in Disaster Relief Coordination" Electronic Journal of Communication. 29 (1-2).

Abstract: The purpose of our study is to explore the construction of authority in disaster relief coordination. We emphasize the ways in which stakeholders draw upon various discursive resources in order to establish or preserve their authority to act within a certain problem domain. We review literature on authority, coordination, communication, and collaborative work to provide a theoretical framework that informs our empirical examples. Next we present a case study of disaster relief coordination in the Philippines following Typhoon Yolanda (known internationally as Haiyan). Our case focuses on home reconstruction in the Cebu province of the Central Visayas region of the Philippines, one of the areas hardest hit by the storm where most of the homes were destroyed or severely damaged. This case demonstrates organizations do not have authority within this problem domain, but instead construct authority through practice and sensemaking in order to accomplish a variety of individual and collective goals; authority is in a constant state of negotiation as various organizations coordinate with each other (or not) to provide effective disaster relief. We conclude with a discussion about the contributions and implications of our research.

Zerio, A., Opdyke, A., and Javernick-Will, A. (2016) "Characterizing Post-Disaster Reconstruction Training Methods and Learning Styles" Engineering Project Organization Journal. 6 (2-4), 142-154. DOI: 10.1080/21573727.2016.1257484

Abstract: Large disasters damage or destroy infrastructure that is then reconstructed through programmes that train community members in construction techniques that reduce future risks. Despite the number of post-disaster reconstruction programmes implemented, there is a dearth of research on education and training in post-disaster contexts. To address this gap, we applied a mixed methods approach based upon experiential learning theory (ELT) to three shelter programmes administered in Eastern Samar, Philippines following Typhoon Haiyan. First, we characterize post-disaster training programmes based on learning modes and then, compared this to the learning styles of community members. To assess learning modes of training programmes, we analysed qualitative data from interview accounts of community members and aid organizations; and, to delineate community member's learning style preferences, we analysed quantitative data from survey questionnaires. Findings show that aid organizations administered training largely in lecture format, aligning with the reflective observation mode of ELT, but lacked diversity in formats represented in other poles of ELT. Moreover, analysis revealed that community members tended to grasp new information in accordance with the concrete experimentation mode, then preferred transforming

newly acquired knowledge via the reflective observation mode. The lecture-based training predominately administered by aid organizations partially aligned with community learning preferences, but fell short in cultivating other forms of knowledge acquisition known to enhance long-term learning.

Other research conducted during the completion of this dissertation included the following publications:

Peer-Reviewed Conference Proceedings

[1] **Opdyke, A.**, Javernick-Will, A., Koschmann, M., and Moench, H. (2016). "A Constitutive Communication Lens of Stakeholder Participation in Post-Disaster Recovery." Proceedings of the 2016 Engineering Project Organization Conference, Cle Elum, WA, June 2016. *Best Paper Award*

[2] Zerio, A., **Opdyke, A.**, and Javernick-Will, A. (2016). "Post-Disaster Reconstruction Training Effectiveness." Proceedings of the 2016 Engineering Project Organization Conference, Cle Elum, WA, June 2016.

[3] **Opdyke, A.**, Javernick-Will, A., Koschmann, M., and Moench, H. (2016). "Characterizing Post-Disaster Shelter Design and Material Selection: Lessons from Typhoon Yolanda in the Philippines." Proceedings of the 2016 Construction Research Congress, San Juan, Puerto Rico, June 2016.

[4] **Opdyke, A.**, Javernick-Will, A., Koschmann, M., and Moench, H. (2015). "Emergent Coordination Practice in Post-Disaster Planning of Infrastructure Systems." Proceedings of the 2015 Engineering Project Organization Conference, Edinburgh, United Kingdom, June 2015.

[5] **Opdyke, A.** and Javernick-Will, A. (2014). "Building Coordination Capacity: Post-Disaster Organizational Twitter Networks." Proceedings of the 2014 Institute of Electrical and Electronics Engineers Global Humanitarian Technology Conference, San Jose, CA, October 2014.

[6] **Opdyke, A.** and Javernick-Will, A. (2014). "Resilient and Sustainable Infrastructure Systems: The Role of Coordination, Stakeholder Participation, and Training in Post-Disaster Construction." Proceedings of the 2014 Engineering Project Organization Conference, Granby, CO, July 2014.

Reports and Blogs

[1] **Opdyke, A.**, Dalgado, D., and Maynard, V. "Philippines 2013 – Typhoon Haiyan Overview." Shelter Projects 2015-2016.

[2] **Opdyke, A.**, Javernick-Will, A., and Koschmann, M. "Typhoon Haiyan: Shelter Case Studies." Mortenson Center in Engineering for Developing Communities, University of Colorado Boulder. January 2017.

[3] **Opdyke, A.** "Participation in Humanitarian Shelter: Policy Brief on Haiyan Response." January 2017.

[4] **Opdyke, A.**, Tabo, P., and Javernick-Will, A. "Urban Sheltering: Evidence on Hosting and Rental Support." Overseas Development Institute Humanitarian Practice Network. January 2017.

[5] **Opdyke, A.** and Javernick-Will, A. "Re-Envisioning Evacuation: Reducing Mortality Through Social Development and Community Sheltering." UNISDR International Disaster Reduction Day. September 2016.

[6] **Opdyke, A.** and Javernick-Will, A. "Co-Creating Knowledge of Resilience Principles through Local Stories." UNISDR International Disaster Reduction Day. October 2015.