



# WPI

## **Developing Resilience Strategies in Cubuy-Lomas, Puerto Rico**

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## Abstract

Cubuy-Lomas is a remote mountainous region of Puerto Rico vulnerable to increasingly severe natural disasters due to climate change. This project collaborated with Id Shaliah, a community-based organization, to conduct a rapid place-based resilience assessment to address community-defined issues. We conducted a literature review to create a seven-dimensional model of community resilience followed by 17 community interviews to understand post-disaster challenges and increase adaptive capacity. We fostered strategic partnerships and pathways to sustainably improve energy independence, water storage, communication, community awareness and funding challenges, which provided opportunities for the Cubuy-Lomas community to access much needed resources, including a \$60,000 solar panel donation.

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## Glossary

**Absorptive capacity:** The community's capacity to effectively manage the consequences of events through established strategies of coping (Cutter et al., 2008).

**Adaptive capacity:** The capability of an individual, asset, or system to adjust to a hazard, benefit from new opportunities, or adapt to change (Cutter et al., 2008).

**Antecedent conditions:** The outcome of location specific multi-level processes that take place within and between social, natural, and built ecosystems, including both inherent vulnerability and inherent resilience (Cutter et al., 2008).

**Bonding social capital:** Strengthening the bonds and support between members of a group in a collective based on culture, religion, ethnicity, and identity (Roque et al., 2020).

**Community:** The totality of social system interactions within a defined geographic space (Cutter et al., 2008).

**Community hubs:** Institutions that provide sanctuary, emergency accommodation, gathering spots and resources, food, medical assistance and communication, and other aid and assistance (McShane & Coffey, 2022).

**Human capital:** The knowledge, skills, and abilities of an individual (Roque et al., 2020).

**Place-based resilience strategies:** Collaborative, long-term strategies implemented within a specific region to address multifaceted and interconnected issues. Researchers and communities create these strategies through collective design, administration, and responsibility, and tailor them to the local requirements. They develop infrastructure, programs, and services through active participation and inclusivity (McShane & Coffey, 2022).

**Place-focused resilience strategies:** Focuses on creating resilient systems and processes within a specific geographic area to improve the long-term sustainability of the local community (McShane & Coffey, 2022).

**Resilience:** The ability of a social system to respond and recover from disasters, containing the conditions necessary to absorb impacts and manage the event, as well as post-event, adaptive processes that allow the system to rearrange, alter, and gain knowledge in reaction to a threat (Cutter et al., 2008).

**Social capital:** A set of social networks characterized by trust and mutual aid, governed by shared regulations, norms, and collective participation (Roque et al., 2020).

## Executive Summary

Puerto Rico faces increasingly severe natural disasters due to human-induced climate change as well as its location in both a hurricane belt and an earthquake-prone region (Palm & Hodgson, 1993). Hurricanes Irma and Maria (2017), earthquakes (2020), and Hurricane Fiona (2022) are recent examples where communities were left isolated and without power due to poor infrastructure and a lack of support from the federal government. In order to increase community resilience, communities need hubs – community-serving spaces providing resources and support – to prepare for and respond to unexpected events (Urban Sustainability Directors Network, n.d.). Resilience literature shows that hubs create higher community-based resilience, which better equips them to handle disasters without long-term damage (Cutter et al., 2008; McShane & Coffey, 2022).

Community resilience is particularly important for remote, mountainous communities like Cubuy-Lomas in the Canóvanas Municipality of eastern Puerto Rico (Figure X). Cubuy-Lomas has an increased level of vulnerability due to its isolation and large elderly population. After Hurricane Maria, residents were without electricity for seven months and had little communication with non-residents for a week (J. Valedón, personal communication, November 21, 2022). Since past experiences have shown that the Cubuy-Lomas community cannot rely on government support after disasters, Id Shaliah, a small, underfunded community-based organization operating out of an abandoned school, is creating a resiliency hub.



**Figure X:** Location of Cubuy-Lomas relative to the island of Puerto Rico.  
(OnTheWorldMap, n.d.; Wikipedia, 2022).

Our project conducted a rapid place-based approach to assess community-defined resiliency needs and develop prioritized strategies to increase adaptive capacity (i.e., the

community's ability to manage the impacts of events through established coping strategies) and thus improve community resilience in Cubuy-Lomas (Cutter et al., 2008). This approach began by conducting a literature review to create a seven-dimensional model to categorize community resilience along the following themes: ecological, social, economic, institutional, infrastructural, community competence, and governance & leadership. The community resilience model served as a framework to systematically assess community resilience strengths and gaps during a short period of time through semi-structured interviews with 17 community members, 2 Canóvanas municipal employees, and 4 external resiliency organizations. Based on our rapid assessment, we collaborated with Id Shaliah to prioritize five areas of resilience to address. We co-developed strategic partnerships and strategies to foster resilience through the Cubuy-Lomas Community Center.



**Figure XX:** The Cubuy-Lomas Community Center.

The five resilience areas and our strategies to address them consisted of the following:

*Alternative **energy** through a rooftop solar installation.* A rooftop solar panel system would provide the community with power at the community center during and after a major disaster. Our team communicated with three solar companies and potential partnering organizations. We met with the Engineers Without Borders University of Wisconsin-Madison (EWB UW-Madison) student chapter, who agreed to start a project at the center for a rooftop solar project. EWB UW-Madison is developing plans to install rooftop solar with \$60,000 of their own funding and will visit the center in late 2023.

*Potable **water** in the form of storage tanks.* A water storage solution is critical for the community to have when there is no running water during and after a major disaster. Our team communicated with two water storage companies and created a plan to install four 1,000-gallon storage tanks with pumps. We received two quotes for the system, \$25,000 from Advance Water Systems and \$7,650 from PJ Plumbing. Id Shaliah will explore these options once they acquire funding.

*A **Community Communication and Outreach Plan** to establish communication within Cubuy-Lomas during hurricane season and disasters.* Id Shaliah needs to be able to contact all of Cubuy-Lomas during and after a major disaster when there is no cellular service. This plan will establish leaders in each sector to talk to each household and prepare them for disasters at the start of hurricane season. They will also be the point of contact between the community center and community members for receiving aid after storms. We created an outline for the plan and recommend Id Shaliah further develop the plan and acquire resources.

***Advertising** materials to showcase the center to the community and external organizations.* Id Shaliah needed resources to promote the center throughout Cubuy-Lomas and to potential donors or partners. Our team developed a flyer and handbook to advertise the community center and explain Id Shaliah. We recommend Id Shaliah utilize and update the handbook to showcase the projects and progress of the center to any potential partners or donors and increase the chance of building and maintaining partnerships.

***Funding** through contacting external organizations to support Id Shaliah.* Id Shaliah expressed a need for additional funding and resources to open and operate the community center. Our team researched potential funding opportunities through contacting large resilience organizations and other nonprofits. We established communication between the nonprofit organization ResilientSEE and Valedón to assess if they could help Id Shaliah. We also created a contact list of organizations and a funding strategic plan that could offer future funding, resources, or partnerships to Id Shaliah.

We provided Id Shaliah resources to build off our work to implement the resilient strategies into the community center. In order to obtain funding, Id Shaliah can update the handbook as needed. They can utilize the established relationship with ResilientSEE, the funding contact list to reach out to more organizations, and the funding strategic plan to evaluate funding options. Any funding acquired can allow Id Shaliah to implement the water storage solution as

well as obtain supplies for the Community Communication and Outreach Plan. Our rapid place-based community resilience assessment and development approach successfully evaluated the adaptive capacity in Cubuy-Lomas with the seven-dimensional model. Future researchers with limited time and funding can use this approach as a framework to help remote grassroots community-based organizations address community-defined resilience needs. Any researchers utilizing this method should introduce themselves prior to arriving to the community, begin contacting organizations that could provide aid as early as possible, and work closely with community members and incorporate their feedback throughout the development of resilience strategies to ensure a place-based approach.

## 1.0 Introduction

In the past 50 years, catastrophic natural disasters catalyzed by human activity have resulted in 3.6 billion deaths and trillions of dollars in damage globally (Fang et al., 2019). In 2019 alone, these disasters crippled the quality of life and infrastructure for 91.3 million people (EM-DAT, 2020). Small island developing states (SIDS) face the highest recurrence of natural disasters in the world, leading to devastating economic impacts and average damage worth 2.1% of the SIDS' GDP per major storm (UNCTAD, 2021). Puerto Rico, the easternmost island of the Greater Antilles, is a SIDS that faces many natural disasters due to its location in both the hurricane belt and an earthquake prone region (Palm & Hodgson, 1993). Puerto Rico has experienced many devastating natural disasters in recent years, such as Hurricanes Irma and Maria in 2017, earthquakes in 2020, and Hurricane Fiona in 2022. In the aftermath of devastating Category 5 Hurricanes Irma and Maria, the island experienced a population decline of about 8% (Meléndez & Hinojosa, 2017).

Community resilience helps communities prepare for, respond to, and recover from unexpected events. Studies show that communities with higher levels of resilience can better manage natural disasters without lasting damage (Cutter et al., 2008; McShane & Coffey, 2022). As a result of the island's unique geographic location, resilience is especially important for many Puerto Rican communities. In addition to major natural disasters, Puerto Ricans must contend with limited territorial resources and inadequate response times from the federal government that often leaves them feeling isolated (Roque et al., 2020). In 2017, the island experienced a \$123 billion municipal debt default, which has caused an ongoing debt crisis and stunted economic growth (Whiteside, 2019). As a result, community members have taken it upon themselves to build community resiliency, provide mutual support during times of crisis, and provide access to resources that may otherwise be unavailable.

Community resilience is especially important for remote communities like Cubuy-Lomas, which is in a remote, mountainous area in the Canóvanas Municipality of eastern Puerto Rico. Canóvanas has an increased level of vulnerability due to its geographical isolation and rapidly rising elderly population; the median age for the municipality has risen over seven years, from 35.5 years in 2010 to 43.8 years in 2022 (United States Census Bureau, 2022). After Hurricane Maria, Cubuy-Lomas was without electricity for seven months. For at least a week following both Hurricanes Maria and Fiona, the community had little to no communication with emergency

responders or other non-residents (J. Valedón, personal communication, November 21, 2022). Even though Hurricane Fiona had a lesser impact than Hurricane Maria, the community had to live without electricity for a week and remained isolated for 24 hours. Additionally, there are many infrastructural challenges associated with natural disasters in Cubuy-Lomas like the loss of property and damage to essential buildings such as hospitals, schools, and fire stations. The inherent vulnerability of Cubuy-Lomas has prompted local organizations to develop resilience strategies that empower residents to independently react and recover from natural disasters.

While community resilience models claim to be comprehensive and widely applicable (Cutter et al., 2008), most studies focus on assessing one aspect of resilience, such as social or economic, to formulate strategies to enhance a community's adaptive capacity (Roque et al., 2020). General resilience models also exist that do not focus on specific strategies (Cutter et al., 2008). Few researchers have created models that focus on prioritized dimensions of resilience within a specific community and then use the framework to assess and improve the inherent resilience and vulnerability within that community. Furthermore, studies tend to lack specific details on how researchers and communities can collaborate together to assess and implement strategies to enhance adaptive capacity (Song et al., 2019).

Our project created a rapid place-based community resilience assessment and development approach to understand community-defined needs and develop prioritized strategies to increase adaptive capacity and thus improve community resilience in Cubuy-Lomas. Our team completed a literature review of existing resiliency models and provided an overview of resiliency hubs. We constructed a prioritized seven-dimensional resiliency model to evaluate the adaptive capacity of a community. Our team conducted 19 interviews with Cubuy-Lomas residents and municipality workers to assess antecedent conditions and used the model to code the information to determine areas for improvement. We also spoke with external resiliency organizations in Puerto Rico to gain a better understanding of similar resilience efforts and learn what strategies Id Shaliah could adopt to operate a successful resilience hub. We then detailed the methods used to develop pertinent strategies for the areas. We explained the outcomes developed from the interviews and use of the model as well as the next steps for implementation of the prioritized strategies.



## 2.0 Background

### 2.1 Review of Existing Community Resilience and Disaster Preparedness Models

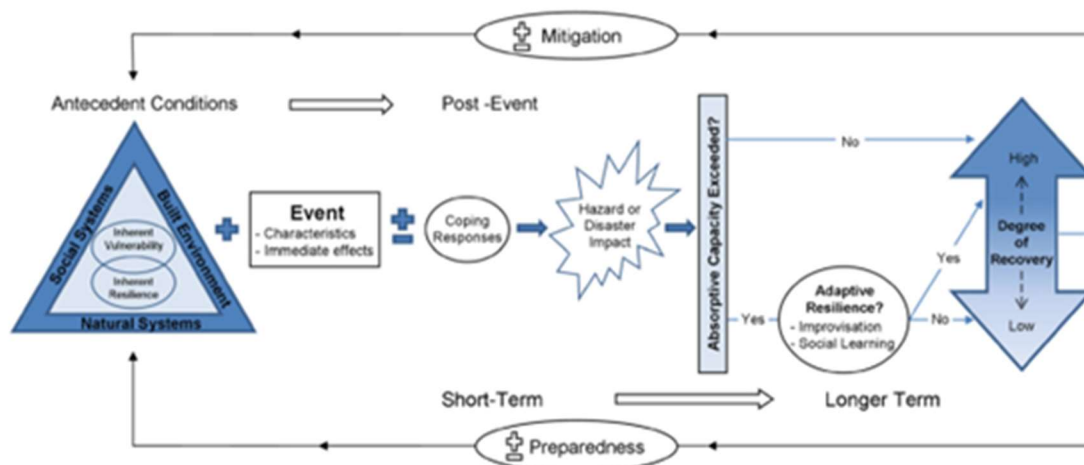
The frequency and intensity of natural disasters is increasing, resulting in compounding destruction worldwide (Clarke et al., 2022). In order to address this, stakeholders from government, industry, community, and academia are transitioning from passively accepting vulnerability to actively developing plans to foster resilience (Cutter et al., 2008). Researchers have proposed various models that attempt to generalize resilience, providing frameworks to define a community's inherent resilience by considering its ever-changing and unique nature in different communities. Numerous studies have investigated the process to define resilience. This section provides an overview of existing frameworks to assist community stakeholders enhance resilience to natural disasters.

### 2.2 Existing Resilience Models

Cutter et al. (2008) defines resilience as a system's capacity to absorb disturbance and reorganize into a fully functioning system. In the context of natural disasters, the authors define community resilience as the ability to prepare for, respond to, and recover from a climate-induced event. The authors propose a community-centered model, with a community defined as "the totality of social system interactions within a defined geographic space" (Cutter et al., 2008). They acknowledge that communities may have sub-populations with varying levels of vulnerability and resilience which impact disaster mitigation strategies.

The basis for Cutter et al.'s (2008) Disaster Resilience of a Place (DROP) model came from Brenkert & Malone (2005)'s Vulnerability-Resilience Indicator Prototype (VRIP). VRIP proposed four components to measure an area's disaster risk: vulnerability, adaptive capacity, exposure to hazards, and resilience. VRIP suggested physical capital and human resources as ways to assess a community's hazard mitigation capability. The DROP model is a complex circular model which begins with the antecedent conditions of a community, including social systems, natural systems, and the built environment, followed by an event. The community's subsequent coping responses then follows, and the model ends with the resulting impact of a hazard or disaster (Figure 1). Five core factors, adaptive capacity, interconnectedness, learning capacity, resourcefulness, and understanding, serve as the foundation for the DROP model.





**Figure 1:** Schematic representation of the DROP model (Cutter et al., 2008).

The adaptive resilience and degree of recovery of a population depend on whether they exceed their community's absorptive capacity. The definition of absorptive capacity is "the ability of the community to absorb event impacts using predetermined coping responses" (Cutter et al., 2008). As a community's absorptive capacity increases, so does its ability to recover from disasters. An increase in resilience not only helps communities recover more quickly and efficiently from disasters, but also provides the opportunity to anticipate and mitigate potential risks. The DROP model built upon the VRIP to produce a model that evaluates community resilience more comprehensively. The DROP model identifies six dimensions that form a community's antecedent conditions: ecological, social, economic, institutional, infrastructure, and community competence. Both a community's inherent vulnerability and inherent state of resilience comprise its antecedent conditions.

Sherrieb et al. (2010) used Cutter et al.'s (2008) DROP model to inform the development of their adaptive capacity model. Cutter et al. (2008) based the DROP model on a multi-scale, multi-level framework that identified five key components of disaster resilience: exposure and vulnerability, social capital, information and communication infrastructure, economic resources, and physical infrastructure. Sherrieb et al.'s (2010) adaptive capacity model built upon this framework by adding two additional components: governance structures and decision-making processes. The authors modified other existing elements of the DROP model to better suit their specific research objectives. This included changing "economic resources" to "financial

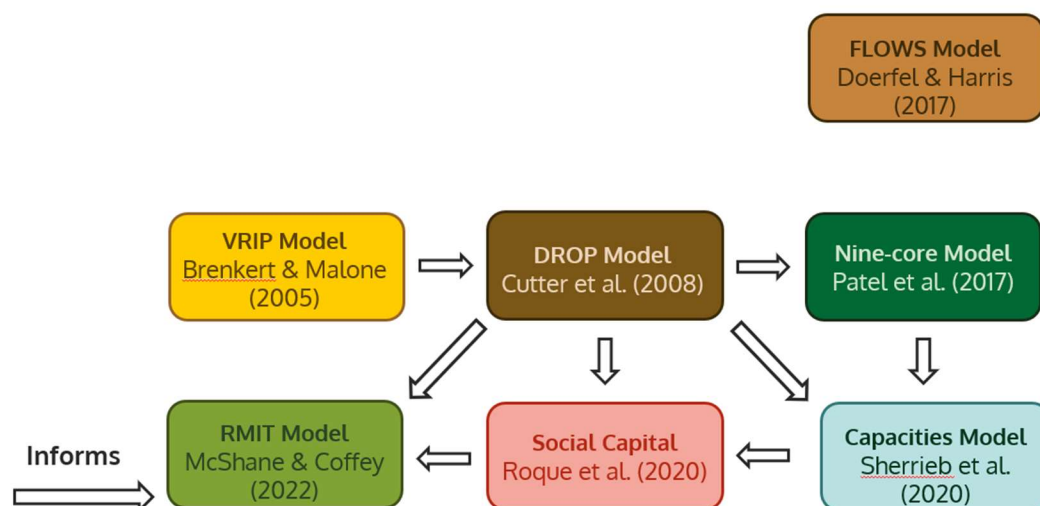
resources” in order to emphasize access to funds that communities could use during emergency response or recovery efforts, rather than just overall wealth levels within a given community.

Patel et al. (2017) expanded the six-dimension DROP model to develop a nine-core resilience model, an attempt to measure a community's “resilience capital”. The nine core elements of community resilience are local knowledge, community networks and relationships, communication, health, governance and leadership, resources, economic investment, preparedness, and mental outlook. Patel et al. (2017) further divided each core element into 19 sub-elements. For example, “local knowledge” included a community’s factual knowledge base, training and education, and collective efficacy and empowerment. The authors recognized the nine-core resilience model as a simplified attempt to conceptualize resilience, noting that its definition varies depending on time and circumstance due to its abstract nature.

Roque et al. (2020) examined the importance of social capital for disaster response and resilience in two rural Puerto Rican barrios, Corcovada and Mariana. Challenges included geographical isolation, lack of emergency services, food insecurity, and need for medication. Following Hurricane Maria, residents demonstrated bonding social capital by helping each other with community needs. For example, youth members used their own equipment to fix physical damage. The study concluded that communities with strong social capital are better prepared to respond and recover from disasters, and that pre-disaster organization, planning and neighborly interactions are essential for building resilience.

McShane & Coffey (2022) built on Roque et al.'s (2020) social capital model to examine the role of community hubs in disaster response and recovery. They focused on resilience hubs in Australia and argued for place-based strategies to strengthen a community's adaptive capacity. These strategies involve community hubs that provide diverse services in health, educational, and social sectors while also promoting social connectedness among residents. Place-based approaches differ from place-focused approaches, which rely on external stakeholders to plan services based on assumed local needs (State Government of Victoria, 2021). Place-based strategies not only consider a place's history, culture, and environment to develop tailored strategies, but also facilitate engagement between community members and external stakeholders, which creates mutual trust. The foundation of trust developed through place-based approaches leads to a higher level of efficacy than those provided by place-focused approaches (State Government of Victoria, 2021).

Doerfel and Harris (2017) proposed the FLOWS model for managing resilience, which emphasizes the importance of formal and informal structures, liaisons that facilitate navigation between them, overall network structures, weak ties that provide information flow, partnerships with stakeholders, shared vision building, and collective action. The FLOWS model supports the notion that resiliency is a complex concept. Doerfel and Harris (2017) suggest that collaboration between organizations can effectively promote the creation of social capital in vulnerable communities. Communities can strengthen social capital through expanding adaptive capacity, involving stakeholders, and increasing public knowledge of possible strategies. The FLOWS model further emphasizes the need for ongoing monitoring to ensure that the strategies maintain long-term sustainability. Figure 2 shows the relation of the seven models. Such models help to build adaptive capacity of a community when implemented through local resilience hubs.



**Figure 2:** Connections between seven key studies on resilience.

The arrows show that each study informed the one before it in the sequence.

## 2.3 Resiliency Hubs

Resilience hubs are community-serving spaces that provide resources and support to individuals, families, and communities in times of disaster (Urban Sustainability Directors Network, n.d.). They identify, develop, and implement tailored strategies given the local context, drawing on the collective knowledge of their members. Resilience hubs can increase the adaptive capacity of a community, enable community members to prepare for future disasters, and

promote social cohesion (Climate Resolve, 2022). Research has identified social cohesion to be the most critical aspect of community resilience (Cagney et al., 2016).

People utilize resiliency hubs worldwide to protect against natural disasters. They exist in various forms. For example, the government of Eilat, Israel created multiple physical spaces for relief during extreme heat waves (Sanderville et al., 2022). Another common method of fostering community resilience is through the expansion of an existing community center to support disaster relief efforts, as seen in the city plans of Cambridge, Massachusetts, for example. The city plans to implement generators, floodproofing measures, and install solar power while also improving the emergency preparedness plan it currently has in place (Executive Office of Energy and Environmental Affairs, 2019).

Resiliency hubs can also be non-physical entities, as seen in the Neighborhood Empowerment Network of California which utilizes a central organization to connect smaller local organizations together to communicate about resiliency in the area. These organizations can talk to individual members of the community who lead resilience efforts at the neighborhood level to create a “hub” of resiliency with many resources for effective communication (Lou, 2020). While these examples are government-based or receive government support, there exists inadequate government response in some areas of the world, leading to many community-based organizations taking the initiative to foster resiliency. This is especially the case in Puerto Rico.

## **2.4 Government Response to Natural Disasters in Puerto Rico**

Puerto Rico is a territory of the United States located in the Greater Antilles of the Caribbean Sea. The United Nations classifies the territory as a Small Island Developing State, or SIDS, due to its vulnerabilities in social, economic, and environmental factors. SIDS heavily depend on external resources for survival (UNCTAD, 2021). Puerto Rico has seen a sharp increase in the frequency and severity of natural disasters due to climate change, leading to severe impacts on its communities (Castle et al., 2020). Hurricanes Maria and Irma in 2017, major earthquakes in 2020, and Hurricane Fiona in 2022 had particularly devastating consequences for communities across the island. These communities initially sought government aid to recover from these natural disasters.

### **2.4.1 Government Response**

The U.S. government has provided inadequate aid to Puerto Rico in the wake of natural disasters (Willison et al., 2018). Hurricanes and earthquakes have left the island struggling for

resources and assistance from the mainland, with Congress allocating only \$42.7 billion of relief funds out of an estimated rebuilding cost between \$90-120 billion (Hispanic Federation, 2019). The federal government tasks the Federal Emergency Management Agency (FEMA) with preparing for and responding to such crises, yet FEMA rejected 60.5% of 1.1 million applicants who sought housing assistance following Hurricane Maria in 2017 (García, 2021). Furthermore, FEMA allocated less than one percent (\$5 million) of its funding towards purchasing generators for water pumps on the island prior to Hurricane Fiona in 2022; only 13 out of 383 promised generators arrived in time, leaving thousands without potable water (Hernández et al., 2022). The slow and negligible response from the government created a need for resilience hubs throughout Puerto Rico that provide resources for recovery efforts beyond those provided by traditional governmental programs.

## 2.5 Cubuy-Lomas, Puerto Rico

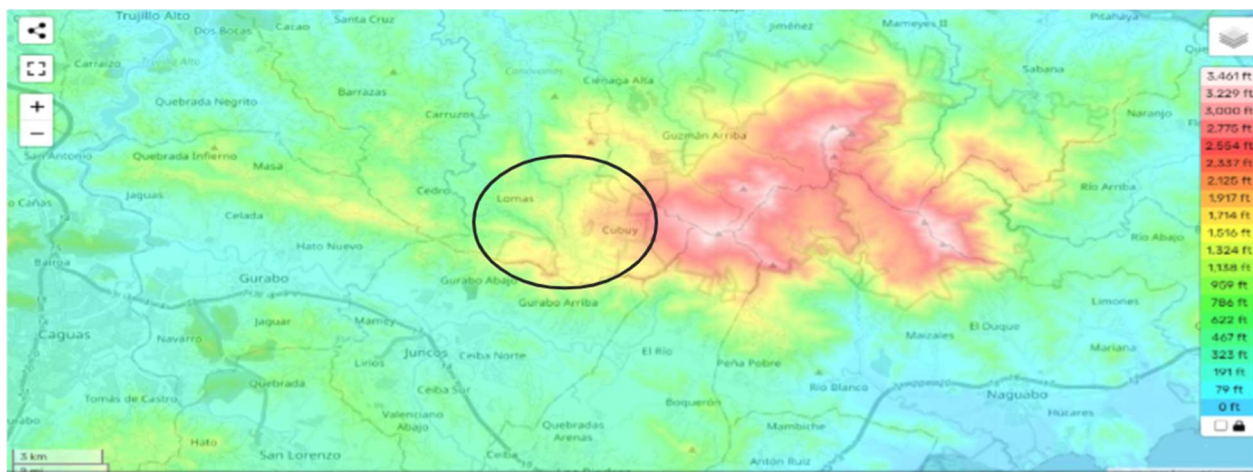
The community of Cubuy-Lomas is located in the eastern region of Puerto Rico, in the Canóvanas municipality (Figure 3).



**Figure 3:** Location of Cubuy-Lomas relative to the island of Puerto Rico. (OnTheWorldMap, n.d.; Wikipedia, 2022).

Approximately 30 minutes from San Juan, Cubuy-Lomas is a mountainous community with a population of about 10,200 people and is particularly vulnerable to climate change due to its high percentage of elderly residents. It is located within Canóvanas, which had a poverty rate of 44% in 2020 (Abetemarco et al., 2019). While United States Census data estimates 30.5% of the population in Cubuy-Lomas is 60 years or older, locals estimate around 70% are over 60 years old (United States Census Bureau, 2021; J. Valedón, personal communication, November 21st, 2022). In 2020, median household incomes in Cubuy and Lomas stood at \$22,857 and

\$14,864, respectively, while employment rates were 32.2% and 63.3%, respectively. Additionally, 3.8% of the population living in Lomas did not have health care coverage compared to 9% living in Cubuy in 2020 (United States Census Bureau: Lomas Comunidad, 2020; United States Census Bureau: Cubuy Barrio, 2020). Furthermore, the topographic map of Cubuy-Lomas (Figure 4) demonstrates the vulnerability of the community due to its relatively high elevation, which makes access to emergency services difficult during extreme weather events such as hurricanes or earthquakes. Consequently, resilience hubs are essential for this vulnerable population who lack basic needs and resources due to their geographical isolation and economic insecurity.

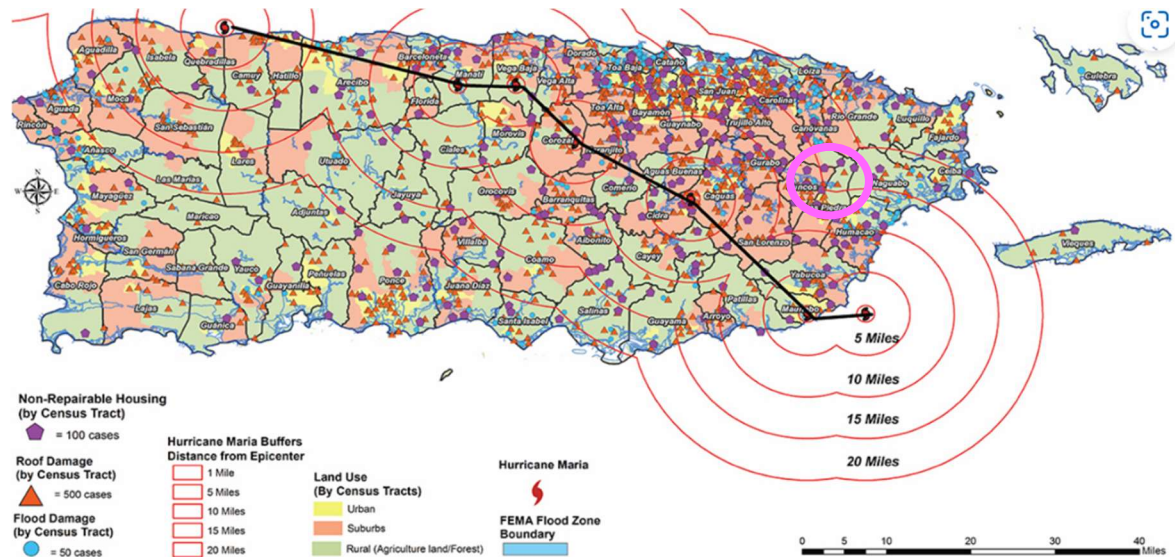


**Figure 4:** Topographic map of Cubuy-Lomas showing an average elevation of 1,870 ft, a maximum elevation of 3,166 ft and minimum elevation of 866 ft. (OpenStreetMap & TessaDEM, 2022).

### 2.5.1 Cubuy-Lomas Response to Natural Disasters

The devastating effects of Hurricanes Maria throughout Puerto Rico and in Cubuy-Lomas in September 2017 (Figure 5) demonstrated the need for resiliency projects. Hurricane Maria resulted in 491 homes damaged, roads blocked due to landslides and treefall, and a seven-month power outage (J. Valedón, personal communication, November 21, 2022). It was clear that the community needed resources to help them quickly bounce back from disasters. Furthermore, Puerto Rico experienced an alarming 62% increase in mortality rate between 2016 and 2017 following Hurricane Maria (Kishore et al., 2018). Creating a resilience hub offering critical resources could help improve the community's ability to withstand future natural disasters.





**Figure 5:** The damage caused by Hurricane Maria across Puerto Rico (Hinojosa & Meléndez, 2018). The circle on the eastern side of the island indicates the location of Cubuy-Lomas.

## 2.5.2 Id Shaliah

Id Shaliah is a non-profit faith-based organization founded by Javier Valedón in May of 2020. Their goal is to provide social and human services to the community of Cubuy-Lomas and nearby areas. The lack of government aid to the region in previous natural disasters has prompted Id Shaliah to act as the main resiliency organization for the community. The organization provides many different programs to the people of Cubuy-Lomas to help mitigate the effects of natural disasters on the community. They also provide community members with food, water, medicine, and medical equipment. Valedón operates out of the Centro de Desarrollo y Servicios Comunitarios Id Shaliah Inc., or the Cubuy-Lomas community center, an abandoned school in Lomas. He identified resiliency needs for the center, such as sustainable water and energy sources, sufficient food supply, and other provisions for the center. Valedón expressed that members of his community have generally underprepared in past natural disasters and emphasized his desire for an educational initiative focused on disaster preparedness (J. Valedón, personal communication November 21, 2022).

## 2.5.3 Existing Work at the Cubuy-Lomas Community Center

Two student groups from Worcester Polytechnic Institute (WPI) worked in Puerto Rico with Id Shaliah from October to December of 2021 to reform the previously abandoned school

into a community center. One group worked to promote the opening of the community center, developed an outreach plan for potential sponsors for the hub, and created a generalized toolkit for opening a community center (Conway et al., 2021). This document details the usage of each room as well as the history and purpose of Id Shaliah. This team planned for Id Shaliah to use these materials for advertising throughout the community and for presentation purposes for potential future partners.

The second group focused on resiliency through researching potential options for the installation of a power system and a reliable water source for the center (Brennan et al., 2021). This team determined a rooftop photovoltaic solar system as the optimal way for obtaining power for the center and completed much of the groundwork for this solution. They measured the total developable rooftop area and recommended fixing some rooftop areas before solar installation. The team received a quote of \$66,000 for the cost of implementing the system. Also, the group created an engineering layout and professional rendering of the solar project design.

Additionally, Brennan et al., (2021) identified a rainwater harvesting system as a potential solution for water. The system would need to ensure that the roof would offer the collection of a sufficient volume of water. They recommended potentially assessing basic treatment options to ensure potable water. They also recommended a groundwater well as a more expensive option that would provide a greater quantity and quality of potable water for the community. Through contacting contractors and engineering groups, the team received estimates for both water strategies. The group also generated lists of potential contacts for the installation of solar and water strategies.

Both groups created an outreach template presentation detailing the work at the center for Id Shaliah to use to present to any potential partners (Brennan et al., 2021; Conway et al., 2021). Id Shaliah utilized these teams' findings to continue work at the community center, with a goal to open it in 2023. The combined work of the two previous groups, along with the continued work of Id Shaliah, has established the framework for the implementation of a resiliency hub within the community of Cubuy-Lomas at the center.



### 3.0 Methodology

The aim of this project was to mitigate the impacts of natural disasters for the residents of Cubuy-Lomas. Our team utilized a rapid place-based community resilience assessment and development approach comprised of two objectives:

1. Systematically identify and prioritize sub-elements that need improvement to increase the adaptive capacity of Cubuy-Lomas
2. Develop strategies to foster resilience through the Cubuy-Lomas Community Center

We worked with Id Shaliah, local community members, and other organizations focused on resilience in Puerto Rico to develop strategies to improve the adaptive capacity of the Cubuy-Lomas community. Our team developed a seven-dimensional model to assess the inherent resilience and vulnerability of Cubuy-Lomas. The expressed needs and wants of community members informed our assessment of the community's resilience. We used the model to categorize elements of resilience that community members prioritized. Once we identified community priorities, we worked to develop feasible strategies to improve the relevant area of resilience and created specific implementation protocols for community resilience strategies. The project began on January 9th, 2023, and concluded on March 3rd, 2023.

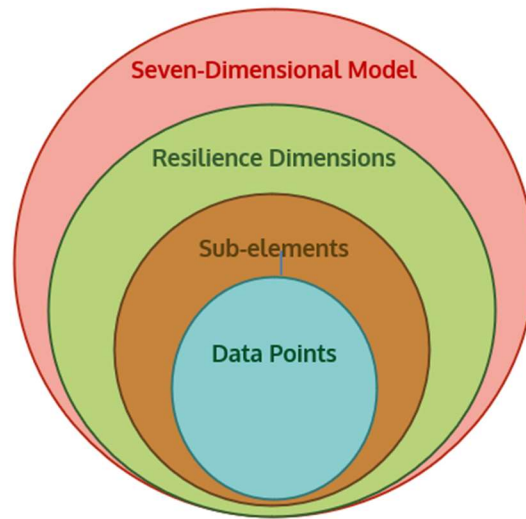
#### 3.1 Method 1: Rapid Place-Based Assessment of Antecedent Conditions in Cubuy-Lomas.

Previous research has established that community resilience is a multi-dimensional concept, requiring the evaluation of multiple factors (Cutter et al., 2008). Drawing from existing literature, our team developed a seven-dimension model composed of three tiers. Each dimension contains sub-elements, which consist of data points that researchers can identify through community-based research. The model synthesized components of Cutter et al.'s (2008) DROP model, Brenkert & Malone's (2005) VRIP model, Patel et al.'s (2017) nine-core approach, Sherrieb et al.'s (2010) capacities model, Roque et al.'s (2020) social capital model, and McShane & Coffey's (2022) social infrastructure model into a seven-dimension framework. We expanded on the six resilience dimensions proposed by Cutter et al. (2008) to include a seventh dimension based on Patel et al. (2017). This resulted in the seven-dimension framework of information categorizing community resilience: ecological, social, economic, institutional, infrastructural, community competence, and governance & leadership. We utilized the model

during our project for a rapid place-based assessment of the antecedent conditions of the community to systematically identify resilience gaps.

Ecological resilience measures an ecosystem's capacity to withstand and recover from natural disasters, with sub-elements such as biodiversity, resource availability, and connectivity (Cutter et al., 2008). Social resilience is the ability of a community to reduce the risk of disasters and adapt to them collectively, with data points including social support, social participation, and demographics (Kwok et al., 2016). Economic resilience refers to a community's economic structure and adaptive capacities, including data such as economic diversity, resource equity, and level of economic resources (Sherrieb et al., 2010). Institutional resilience gauges a system, organization, or institution's ability to withstand, recover from, and adapt to natural disasters, with data points including organizational structure, capacity, leadership, training, and experience (Tierney & Bruneau, 2007). Infrastructural resilience refers to physical systems that support human activities and access to resources, with data points such as infrastructure design and housing quality, water supply management, waste management, access to a generator, and solar panels (Cutter et al., 2008). Community competence assesses the ability of a community to function before and after a disaster, with data points such as psychological coping strategies, knowledge and information, skills and capabilities, and attitudes and values (Norris et al., 2008; Vale & Campanella, 2005). Governance and leadership resilience refers to the capacity of an organization and its leaders to maintain their performance and operations in the face of natural disasters, with data points such as legal framework, governing organizations, and community leadership (Patel et al., 2017). We created a table detailing each dimension and the sub-elements and data points that fall under each (see Appendix C).

Our team's framework contains a hierarchy of components which fall under each resilience dimension (see Figure 6). We conducted research within the community to identify specific sub-elements in each of the seven dimensions.



**Figure 6:** Hierarchy of components in the seven-dimensional model.

### 3.1.1 Data Collection Process

Assessing the antecedent conditions in Cubuy-Lomas was essential for our team to construct effective strategies that promote resilience. By doing so, we gained a comprehensive understanding of the community context, including physical and social elements, socio-economic and cultural dynamics, as well as environmental and climate risks. Taking this step prior to devising strategies enabled us to create a more thorough approach to resilience-building that considers multidimensional aspects of the community alongside its vulnerabilities.

Prior to the interviews in the community, our team created a video and informational flyer introducing ourselves and our project which Javier Valedón uploaded to the Id Shaliah Facebook page. Since many community members follow the page, this enabled us to establish familiarity and trust among community members and encouraged them to share their experiences upon our arrival.

We conducted semi-structured interviews to build interpersonal connections with the participants and learn about their resiliency needs. We based the data collection on key data points within each sub-dimension of our resilience model. Our team interviewed three groups in Puerto Rico: 17 Cubuy-Lomas community members, 2 Canóvanas municipal employees, and 4 external resiliency organizations to develop strategies based on their current needs, available resources, and past experiences.

### 3.1.2 Community Interviews

Our team collected data using a human-centered approach, traveling to three different areas, defined as sectores, of Cubuy-Lomas to meet community members. We developed interview questions tailored to specific community groups (see Appendix A). We asked the elderly people about their family history in the area and the difficulties they have preparing for storms, while we asked workers about community and working challenges after storms impact the area. Additionally, we asked everyone about their experiences during the most recent hurricanes, Maria and Fiona, including the preparation done and their experiences during and after the storms. We also asked community members what resources they would like to have for the next major hurricane to reduce its impacts. These questions helped our team assess the antecedent conditions of the community to determine the strategies that we would develop. Our team spent time in the sectores of Marines, Los Caf , and Parcelas Ben tez, interviewing twelve community members in total.

We interviewed three people associated with Id Shaliah to understand the needs and vision for the center: founder, Javier Valed n, board member, Genaro Negr n, and volunteer Omar Estrada. Using a semi-structured interview format, we spoke with Valed n to learn about the center and structure of Id Shaliah. Our team asked him to describe the roles of board members, the current funding Id Shaliah has, their current source of water and power, and Valed n's relationship with the municipal government. In the interviews with Omar and Genaro, our team asked about their roles within Id Shaliah, including daily work and work during hurricane season. We also asked the three members about what resources and tools they want the organization to have for the next storms at the center (see Appendix A)..

Additionally, we interviewed the mayor, Lornna Soto, and Police Officer Hector Zambrana of the Can vanas municipality. We asked about the structure of the police, fire, and emergency services, the efforts of the municipality to reduce storm damage before, during and after Hurricane Fiona, and the difficulties they faced accessing Cubuy-Lomas after a storm, given it is the most remote part of the municipality (see Appendix A).

Our team compiled audio recordings, transcripts, and notes from the community interviews for analysis and coding. We used a combination of inductive and deductive coding to identify key words and terms in our model that community members frequently mentioned. We associated the descriptions of issues that community members and Id Shaliah frequently spoke

about with specific data points of sub-elements in each dimension. For example, if residents described that they frequently had to use generators due to the loss of power, we would associate this with the infrastructure dimension of our model, as the need for generators is a data point within the resource allocation sub-element.

### **3.1.3 External Interviews**

We interviewed external resiliency organizations based in or that have worked within Puerto Rico. In order to gain a better understanding of successful resiliency efforts in Puerto Rico, we researched, compiled, and contacted organizations ranging from independent community centers to larger organizations spanning many communities. Through this process, we secured four formal interviews. We asked about the work their organization did, hardships frequently seen in Puerto Rican communities, funding sources, and their advice for small resiliency organizations. These interviews helped us understand the strategies other organizations implemented for common issues seen across Puerto Rico and shaped how Id Shaliah and our team went about searching for funding sources for a small resiliency organization. We also used these meetings to inform other organizations about Id Shaliah to hopefully find partners or support networks for Id Shaliah in the future. The questions from external interviews are in Appendix B. This data helped us develop resilient strategies specific to Cubuy-Lomas that consider successful tactics from outside sources.

## **3.2 Method 2: Develop Resilient Strategies to Foster Resilience in Cubuy-Lomas**

After assessing the community's resilience, we created a list of strategies to increase the adaptive capacity of the community center and Cubuy-Lomas for future natural disasters. Our team developed strategies based on coded interviews and previous research by Conway et al. (2021) and Brennan et al. (2021). The strategies addressed the needs of community members and supported the work at the community center. We used the FLOWS approach (Doerfel & Harris, 2017) as a framework.

Once we developed specific resiliency measures based on the community interviews and coding process, our team presented these potential strategies to a diverse group of stakeholders including Id Shaliah, community members, and advisors. We prioritized strategies alongside these stakeholders based on factors such as implementation feasibility and community resources, costs, and time constraints. We modified the ideas for these strategies through an iterative feedback process with key stakeholders. We then conducted further research for each solution to

complete a proposal before the project moved into the planning and implementation stages, all while ensuring that the community directly informed and approved any strategies we developed.

### **3.2.1 Contact Plan**

After community feedback, our team began to develop a generalized external contact plan for the selected resilience strategies. This plan could provide Id Shaliah monetary and engineering aid for each strategy as necessary. Our team created a plan to research relevant companies, non-profit organizations, and other resilient foundations that could provide support at the community center. After assessing the past work, we planned to create a list that categorized each organization into whichever strategy they could support. Through emails and phone calls, contacting these centers allowed us to potentially find Id Shaliah needed aid as well as promote the center throughout the island that to foster future connections.

A challenge that Id Shaliah has to contend with is that the government does not have resources to support adequate resilience efforts in Puerto Rico. Thus, it was critical that our team looked to establish potential partnerships with other organizations. There are a vast number of NGOs, nonprofits, and other groups that could be relevant to the project in Puerto Rico. There are nearly 3,500 nonprofit organizations based in Puerto Rico alone (Internal Revenue Service, 2022). Additionally, there was the potential for any number of nonprofit organizations outside of Puerto Rico that could have provided support through funding or donations to our project. We had to make strategic decisions regarding each organization based on their other projects in Puerto Rico, the resources they can provide, and other considerations.

### **3.3 Methodology Limitations**

When conducting interviews with community members in Cubuy-Lomas to identify what areas of resilience are most important and which we should prioritize, there were certain challenges that we had to address. The time constraint of eight weeks limited the amount of time our team spent in the community understanding its needs. Ideally, our team would have spent more time interviewing to have a fully developed analysis of Cubuy-Lomas to best understand the strategies we needed to develop for the community center. However, the seven-dimensional model had the capability for our team to utilize it for a rapid place-based assessment of the community. Also, cultural differences led to misunderstandings or misinterpretations between the interviewer and interviewee, as the Puerto Rican accent of Spanish was unfamiliar to our team. Despite our introductory flyer and video, community members may have still viewed us as

outsiders and thus could have withheld information during interviews. It was also critical to receive guidance from Id Shaliah regarding existing relationships and other internal considerations for collaborating with any external partners.

Our team will not be there to help the Cubuy-Lomas community and Id Shaliah with executing any implementation of the strategies, which could lead to further delays in the process. Measuring the success of each strategy after implementation could also be difficult due to the presence of numerous variables and the time required for such an evaluation. Our team did not accomplish all the work needed for implementation of all strategies during the term. Future partner organizations or researchers could continue the implementation work of the project.

## **4.0 Findings**

### **4.1 Assessing Community Resilience in Cubuy-Lomas**

This section describes our findings from the community interviews and the methods used to interpret the data to devise strategies to foster resilience within Cubuy-Lomas. We begin with a description of the key issues after major natural disasters that residents articulated in interviews. We then discussed the use of the seven-dimensional model we developed to code interview data and identify the community's unmet needs as well as areas where community members felt less prepared. We finally explain the work done by our team in each area to improve the adaptive capacity of Cubuy-Lomas.

From our interviews, three major themes emerged relevant to the adaptive capacity of the area and the work at the community center under Id Shaliah. All interviewees emphasized the lack of running water for days, the lack of power for months, and the inability to communicate with others after impactful natural disasters.

Community members cited power as a prevalent issue in daily life, especially after hurricanes. Even without disaster, the power goes out every two to three days during some parts of the year. Many community members expressed that there was no power for seven to nine months after Hurricane Maria. (J. Valedón & Jorge, personal communication, January 17, 2023). Those who had electric stoves were unable to cook for months (H. Vega, personal communication, January 12, 2023). Many community members did not own generators and those who did often struggled to acquire gasoline after a disaster due to lines at gas stations (Junior, personal communication, January 20, 2023). Most community members cited improvements to

the power grid as the most critical concern that a government or other entity needed to address prior to the next hurricane season (H. Vega & J. Valedón personal communication, January 12 & January 17, 2023).

Community members also cited challenges around obtaining potable water after storms. For example, water was not available for a week after Hurricane Fiona (H. Vega, personal communication, January 12, 2023). Despite purchasing or receiving water from the municipality, many homes did not have enough water to last after the storm until aid arrived. This resulted in people turning to the rivers for drinking water, which led to cases of leptospirosis (J. Valedón, personal communication, January 17, 2023). The hurricanes also caused long-term damage to the water system. Damage from Hurricane Maria, which occurred in 2017, led to no potable water for seven weeks in 2019 (David, personal communication, January 12, 2023).

Another issue that people frequently raised was the lack of reliable means of communication. After Hurricane Maria, there was no cellular service for three weeks in Cubuy-Lomas. Those who had family elsewhere could not convey to these people that they were alive until service returned. Community members could not even travel to communicate in person with neighbors due to the landslides and downed trees impacting the roads. After Hurricane Maria, people traveled on foot for three days to check on neighbors as there was no way of knowing who needed aid. It took up to two weeks for community members to know if loved ones in other Cubuy-Lomas sectores were alive and well (G. Negrón, personal communication, January 30, 2023). Normally, municipalities would have workers, such as police officers, who function as first responders and check on houses immediately after storms. However, Canóvanas is severely understaffed and lacks resources, with only eight police officers for the entire municipality; the police themselves indicated they should have around 50 more officers (H. Zambrana, personal communication, February 2, 2023). Id Shaliah members also indicated that the organization needs a better system to reach out to community members (J. Valedón, personal communication, January 17, 2023).

Many community members were also unaware of Valedón's plans for the community center. The owner of the community market knew of Id Shaliah but was not aware of the specific services offered at the center (Jorge, personal communication, January 18, 2023). ID Shaliah mainly advertises the center through Facebook, which not all community members follow. A community member who did not have a cellphone or social media stated that he bought breakfast



from Valedón at the center but did not know of the services Id Shaliah planned to offer (Pavo, personal communication, January 18, 2023).

Based on the findings from interviews, our team identified three main areas that need improvement within the community to increase adaptive capacity: water, power, and communication. We recognized that for the community center to promote resilience in Cubuy-Lomas, Id Shaliah should work towards providing access to potable water, a source of power, and a way to communicate with others after disasters. Our team and Id Shaliah also identified that informing the community and external organizations about the work done at the center was critical for the success of the resilience efforts. Thus, creating advertising material also became an area to address for our project. Finally, all four of these areas, as well as any other work within the center, would require funding. Id Shaliah indicated that they did not have the money for any large project for the center and hoped to pursue partnerships or grants for funding. We researched funding opportunities for the organization as our final area of work.

#### **4.1.1 Use of the Seven-Dimensional Model**

The findings from our interviews with community members and Id Shaliah gave us information that we could code through our seven-dimensional model. The lack of potable water during hurricanes correlates to the data points of water scarcity and quality, both within the resource availability sub-element of ecological dimension, as well as water supply management in the emergency preparedness sub-indicator of the infrastructure dimension. Community members often remedied power issues using generators and solar panels, which are both data points in the resource allocation sub-element of the infrastructure dimension. The lack of cellular service led to limited communication within Cubuy-Lomas, which cites the need for disaster communication protocols and response coordination, both data points within the social participation sub-element of the social dimension. The lack of knowledge about the center and Id Shaliah's desire for increasing awareness about the work done and services offered fell into the effectiveness of communication platforms in the social support sub-element of the social dimension. Finally, the strategies we identified require funding from external partnerships and sources. This fell under the economic diversity sub-element of the economic dimension. The work done in Cubuy-Lomas shows that researchers can apply the model to any given community through data collection and coding. Additionally, our team identified five out of seven

dimensions as pressing needs within Cubuy-Lomas through the interview period, showing how communities are vulnerable across multiple dimensions.

The five areas we identified for developing strategies at the community center were:

1. **Power** to allow the center to operate during disasters
2. **Water** for the community during disasters
3. A **Community Communication and Outreach Plan** to connect the community to the center
4. **Advertising** to attract community members, external organizations, and partnerships for future projects
5. **Funding** to support immediate projects at the center

## 4.2 Developing Resiliency Strategies

Once our team determined the five strategic areas based on interviews, we presented the findings to Id Shaliah leadership and the community. Id Shaliah approved the five areas for our team to work in and agreed that each area was equally critical for fostering resiliency in Cubuy-Lomas and for the success of the center. We also agreed that our team could develop strategies in the five areas simultaneously to provide Id Shaliah with as many resources as possible at the end of our project.

### 4.2.1 Energy Improvements

The insufficient power infrastructure in Cubuy-Lomas has made energy a critical matter. Our team determined that a rooftop solar installation was an ideal solution based on the research of Brennan et al. (2021). This group recommended a rooftop solar installation due to the unreliable power connection to the community center and ample rooftop space that received sunlight. We contacted 18 solar companies (see Appendix D) in Puerto Rico and larger solar companies with global reach that have worked in the Caribbean to assess the site, donate solar equipment, or help build the project. Out of the 18 companies, two companies got back to us with information about their work. Our team met with a representative from Golden Solar Technologies to discuss the project. After providing the information we had on the rooftop area, the representative said based on their experience, the project was too early in the planning stages for any solar company to develop the project. After having a low success rate with solar companies, our team contacted an Engineers Without Borders (EWB) student chapter from the University of Wisconsin at Madison (UW-Madison). They previously worked on a solar and

rainwater harvesting project in Parcelas Benítez, a sector in Cubuy-Lomas about one mile from our center. We met to discuss a solar project at the Cubuy-Lomas Community Center during their process of searching for a new project in Puerto Rico. EWB UW-Madison had an estimated \$60,000 for a solar project and an established relationship with Javier Valedón, and ultimately decided to move forward with developing the rooftop solar installation at the community center. The UW-Madison team began preliminary work on expanding their solar design to encompass the entire center and established multiple meetings with Valedón and Id Shaliah. They expect to first travel to the community in late 2023.

#### **4.2.2 Water Improvements**

The research conducted by Brennan et al. (2021) provided two potential water access and storage strategies for emergency use at the center, a rainwater harvesting system and a well, as well as cost estimates and a contact list for both. We expanded the contact list for water storage tanks and well drilling companies to start our research. We focused on suppliers and drillers in Puerto Rico or who have done extensive work in the Caribbean and contacted 13 companies, listed in Appendix D.

After securing a site visit with Puerto Rico-based company Advance Water Systems (AWS), our team, along with the AWS representative and Valedón, developed a third, alternative solution that would better suit the needs of the community center. We created a plan for a water storage system that would feed off the municipal water supply. This solution was a cheaper alternative to a well or rainwater harvesting system and would require no extensive treatment procedures besides cleaning the tanks. The plan included four 1,000-gallon polyethylene water tanks, smart pumps that detect when they need to pump water into the tanks, CPVC piping, and an underground electric connection. The chosen site was a small pavilion seen in Figure 7, as it would provide sufficient protection for the tanks during storms. Our team received a quote for the system from AWS of approximately \$25,000. Id Shaliah received another quote from PJ Plumbing, a Lomas-based company with an established relationship with Valedón, for \$7,650. Id Shaliah preferred working with a known partner for a much cheaper price, and the team gathered the details on the types of materials PJ Plumbing plans to use for a future team to assess the project.



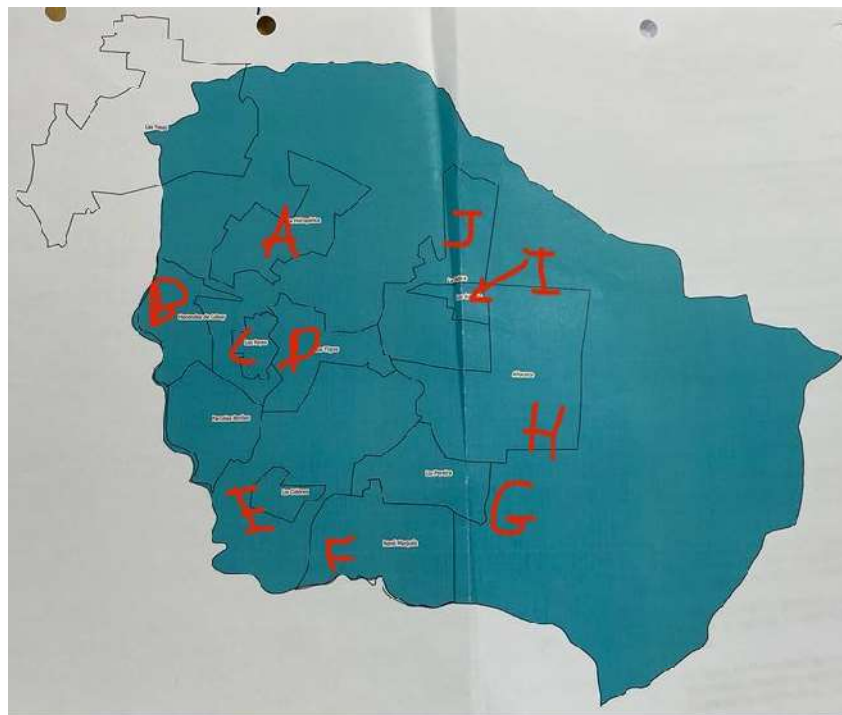
**Figure 7:** Pavilion site for the proposed water tank system.

#### **4.2.3 Community Communication and Outreach Plan**

Id Shaliah and our team determined a communication network between the community center and Cubuy-Lomas was key to the organization's efforts. Since the municipality lacks the resources to provide aid before, during, and after storms, Id Shaliah plans to serve as the main provider. The center will provide medical assistance, emergency medical supplies, food, water and manpower to help Cubuy-Lomas recover from a disaster. Id Shaliah needed a system to connect with community members before and after disasters to provide support for preparedness and recovery, which we developed in the Community Communication and Outreach Plan.

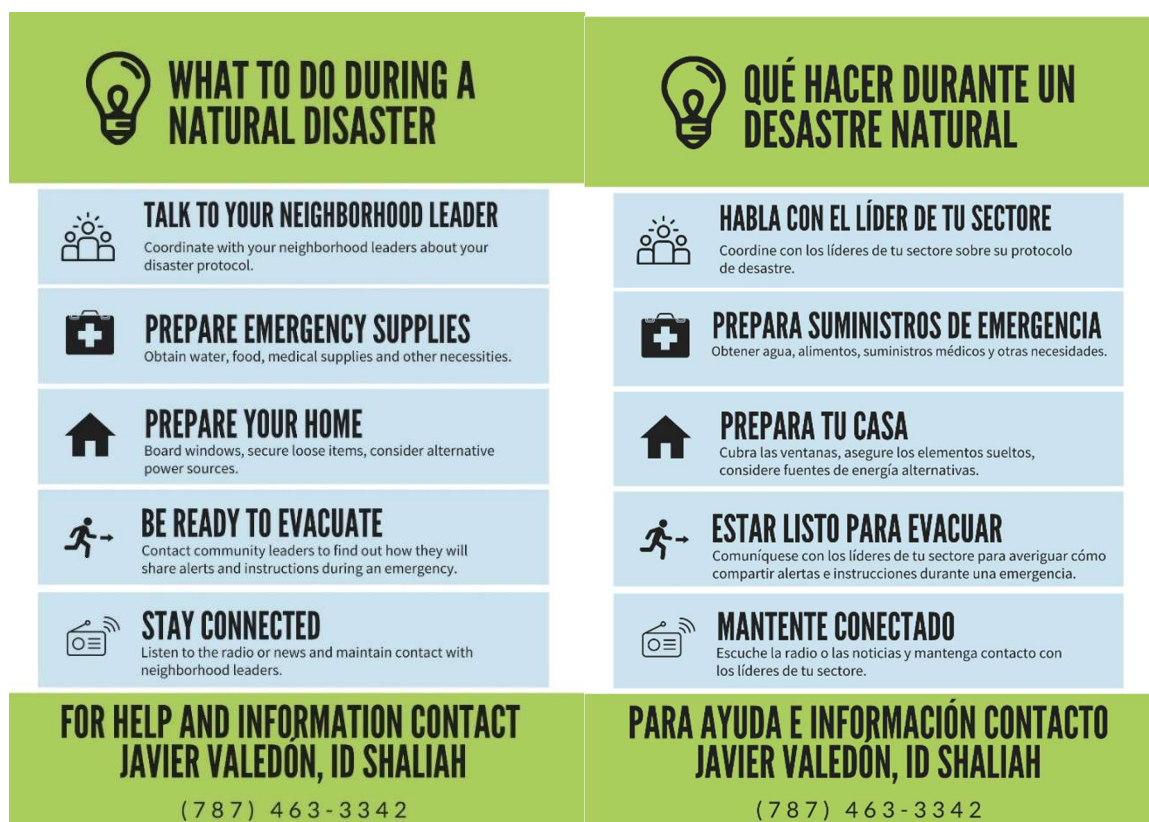
We first needed to understand the area that the community center would serve in disaster. Our team obtained maps of all the sectores within Cubuy and Lomas from Valedón, as seen in Figures 8a and 8b, respectively. These 24 sectores were the designated zones Id Shaliah wanted to have contact point(s) in before, during, and after each storm. Through conversations with Id Shaliah members, we determined that each sector should have one to five leaders appointed by Id Shaliah, based on the population of the sector, to act as the communication lead. This leader would distribute a flyer (Figure 9) which contains a checklist for hurricane preparation and contact information of Id Shaliah. Leaders will talk to each household in the sector before hurricane season to assess their disaster preparedness using a questionnaire (Appendix E). The community leader would report the findings of the first assessment to Id Shaliah, who then would provide supplies and support to whichever households need them before a storm. The leaders will also act as an immediate contact after storms even with no power, service, or

navigable roadways, which is essential to recovery efforts. We also suggested that leaders go to each household in the days prior to major hurricanes with the questionnaire to ensure each house fully prepares. We provided an overview of the plan in Appendix E.



**Figures 8a & 8b:** Maps of Sectores in Lomas (8a) and Cubuy (8b). The green and brown areas with black boundaries in 8a denote sectores in Lomas, while the blue areas with black boundaries in 8b denote sectores in Cubuy. Note one sector, Las Yayas, is in Cubuy and Lomas, as seen in the top left of Figure 8b.





**Figure 9:** English and Spanish Versions of the Cubuy-Lomas Disaster Preparedness Flyer.

#### 4.2.4 Advertising Material

After analyzing the data collected through community member interviews and speaking with Id Shaliah, we learned that the community did not have much knowledge on the services Id Shaliah planned to offer. We wanted to increase awareness about their work and advertise the services offered by the community center to community members, future partners, and potential funding organizations. Thus, our team created a community flyer (Figure 10) and community center handbook. The flyer provides a brief description of the community center, while the handbook contains a detailed description of our sponsor, Id Shaliah, the goals for the center, the services offered, and the progress made so far. The handbook also includes a blueprint of the floor layout at the center that our team measured. Id Shaliah can use the flyer to reach out to local community members to promote activities and frequent visits to the center, while also giving people a critical point of contact during emergencies. Conway et al. (2021) created a toolkit for the community center, which we used as a framework to develop an updated handbook. We intend for it to advertise the services at the community center and for Id Shaliah

to provide this material to future organizations that show interest in creating a partnership, donating goods, or providing funds to the center. It will provide a holistic overview of the center and Id Shaliah, proving that they are a reputable organization working hard towards a good cause. We made the handbook in an editable format so that Id Shaliah can update the photographs and activities at the center as events and services evolve.



**Figures 10a and 10b:** English and Spanish versions of the advertising flyer for the Cubuy-Lomas Community Center.

#### 4.2.5 External Resiliency Organizations and Funding for the Community Center

Our team created a list of external resiliency organizations to contact (Appendix D) and we were able to meet with four resiliency organizations that have done work in Puerto Rico: Hispanic Federation and ResilientSEE, two large organizations who provide funding and aid to many different communities, as well as Fue Que Transforma and PlenitudPR, two small community-based organizations similar to Id Shaliah in scope. Each organization services areas within Puerto Rico, working to develop potable water and energy strategies, distribute food and supplies, and provide medical care.

Hispanic Federation and ResilientSEE have provided funding for projects within communities in the past after receiving money from external sources. Hispanic Federation had a majority of their funding from large personal donations, but both organizations plan to apply to or had received federal grants for funding. The largest grant went to ResilientSEE, which received an \$8.7 million grant from FEMA. Fe Que Transforma and Plenitud PR both spoke about how they obtained funding as small organizations. Fe Que Transforma received \$380,000 in monetary and supply donations from large organizations such as Walmart and Feeding America and have also received FEMA grants. PlenitudPR primarily received funding through grants from government entities, such as FEMA, as well.

All four organizations noted the large bureaucratic hurdles and lengthy processes that come with seeking government funding. When asked about what new resilience organizations need to succeed, the four organizations emphasized having secure funding, a strong organizational structure, a long-term plan, and an understanding of community needs. Our team concluded that Id Shaliah was a good candidate for funding from large organizations, as it is a registered nonprofit with a committed leader, a long-term lease period of 15 years through the municipality, and an organization structure with eight board members. The positions filled by the board members are President, Vice President, Treasurer, Secretary, Operational Director, Accountant, Advisor, and Spokesperson. Both Valedón and these organizations spoke against the feasibility of acquiring grant money from the federal government in a reasonable time frame.

Our team researched potential funding opportunities through external resilience organizations. While Valedón could not give us an exact number, he estimated installation costs plus running the café for one to two days a month could cost \$15 to \$20 thousand monthly. In the process of contacting resilience organizations, we determined that larger organizations had the capacity to provide the necessary funding to support the community center. We reached out to 11 foundations and nonprofit organizations and received responses from two of them, but ultimately never established meetings due to time constraints. However, ResilientSEE, who we had initially only contacted to understand resiliency efforts in Puerto Rico, took interest in Id Shaliah during our initial meeting with them. Id Shaliah held an initial meeting with ResilientSEE to explore the possibility of collaborating. We provided ResilientSEE with the name and 501c3 number of Id Shaliah, a brochure regarding the community center, a copy of the 15-year lease between the municipality and the community center, captioned photographs of the facility, and a video tour of



the center. Additionally, we measured and created blueprints of the center for the organization. ResilientSEE agreed to offer future assistance and funding for endeavors at the community center. Our team created a list of other external organizations that Valedón could contact in the future for funding purposes, as seen in Appendix D. Also, Appendix F contains the funding strategic plan, detailing the benefits and drawbacks of potential funding sources. By utilizing the handbook and flyer our team developed describing the center, our team hopes Id Shaliah can create a future partnership for funding and support.

#### **4.2.6 Additional Issues**

There were additional issues mentioned by community members during interviews, such as the poor conditions of the roads due to downed trees and landslides that are common after storms. We acknowledge that addressing some issues, such as roadway improvements, are beyond the scope of our eight-week assessment. However, the strategies we develop can mitigate other issues faced by Cubuy-Lomas. For example, while our team did not address the travel obstacles after storms, the development of a community outreach plan to connect community leaders with radios during storms could mitigate connectivity problems. It can prevent the need for physical travel to some places and allow Id Shaliah and responders to identify the areas that they need to access first. While we believe we were able to address many major issues for Id Shaliah's community center launch, future team(s) could support additional work based on Id Shaliah's needs once the center opens.

## **5.0 Conclusions and Recommendations**

In this project, we worked to mitigate the impacts of natural disasters on the residents of Cubuy-Lomas through work with Id Shaliah, a local nonprofit. Cubuy-Lomas is highly vulnerable to natural disasters due to its remote mountainous location. Due to poor government support, the community lacks access to basic emergency services and resources to prepare for and recover from natural disasters. We conducted a rapid place-based community assessment of the antecedent conditions in Cubuy-Lomas to determine which areas of resilience needed improvement based on analysis using our seven-dimensional resilience model.

Based on the results of the community assessment, our team developed strategies to create a rooftop solar installation plan, improve the accessibility and quality of potable water, create an emergency communication and outreach plan, raise awareness about the community

center for Cubuy-Lomas community members and external organizations and acquire funding for projects at the center.

Our team identified the creation of an alternative energy source as a pressing need through community member interviews. We determined a rooftop solar installation as the most feasible solution based on the infrastructure of community center and research conducted by Brennan et al. (2021). Our team contacted EWB-UW Madison about the solar installation, and they have started working on the project and plan to visit the center in late 2023. Regarding improving the quality of potable water, we established a site visit from Advance Water Systems (AWS). We created a plan for a water storage system fed by the municipal water supply, would best suit the center's needs. AWS provided a quote of \$25,000, while PJ Plumbing, a second company with an established relationship with Valedón, quoted it for \$7,650. The team gathered information on the materials PJ Plumbing plans to use for a future team to assess its feasibility.

We created a Community Communication and Outreach Plan (CCOP) to help community members before and after an emergency. Our team recommended Id Shaliah assign at least one community leader to each sector. The leader would distribute informational flyers, assess each household with a preparedness questionnaire, and report results to Id Shaliah during the start of the hurricane season. Id Shaliah would provide resources based on the results, which the leader would distribute. In the days before a hurricane, the leader would visit the vulnerable households to provide them with any additional resources they might still need to prepare for the hurricane.

Furthermore, to raise awareness about the work done and services offered in the community center amongst community members and external organizations, we created advertising materials. This included a handbook detailing all the services offered at the center as well as the history and future goals of Id Shaliah. We also created an informational flyer for the center. Additionally, to support the future efforts of Id Shaliah at the center, we reached out to multiple funding organizations and established a relationship with an organization ResilientSEE, which could provide monetary and engineering support to the center. We also created a list of external organizations that Id Shaliah could contact in the future for funding purposes.

The following recommendations are for Id Shaliah based on the developed strategies. These recommendations address important areas that we were unable to address within the eight week project period. Id Shaliah, along with support from future researchers, partners, and other collaborators, can address the following areas to foster resilience in Cubuy-Lomas.

**1. We recommend Id Shaliah utilize and update the handbook to showcase the projects and progress of the center to any potential partners or donors.**

Having an up-to-date handbook detailing the community center will allow Id Shaliah to showcase to potential partners that the center is a professional, organized, and well-run facility. Resilience and funding organizations that we spoke to emphasized the need for small resiliency organizations to have professional advertising materials to increase the odds of obtaining funding. It will give organizations confidence in the center's abilities and show that the center provides the best services and support to the Cubuy-Lomas community. Id Shaliah could also use this handbook to build and maintain existing partnerships. As the community center updates, Id Shaliah can update the photos of the rooms, the descriptions of the services provided, and descriptions of any partners or donors.

**2. We recommend Id Shaliah establish community leaders in each sector and acquire resources to help prepare and recover from hurricanes.**

In order to increase effectiveness of the Community Communication and Outreach Plan, long distance radios will be beneficial for communication between the leaders and Id Shaliah members. Id Shaliah staff and Valedón emphasized the need for the community center to have ATVs or similar off-road vehicles for travel when landslides and downed trees from storms impede or damage the roadways. They also stated a future goal is to have chainsaws and construction vehicles, such as loaders, to clear the roads from fallen debris. These resources would allow for communication and travel during and after storms so that Id Shaliah can quickly identify which sectores need the most help. Id Shaliah should assess the effectiveness of the current community outreach plan during the next hurricane season and make changes as necessary.

**3. We recommend that Id Shaliah develop a detailed cost report containing the initial investments needed as well as operational and maintenance costs.**

Id Shaliah is undertaking a major project in opening the community center, something in which it is critical to have a comprehensive understanding of the associated costs. A detailed cost report would provide an overview of all the costs associated with opening the center and running it daily. Additionally, having a detailed cost report can help to ensure that Id Shaliah allocates resources more efficiently. This information will help Id Shaliah plan their budget and ensure that they are aware of any hidden costs that could arise during the project. Furthermore, this will

help them understand how much money they need to raise to open and maintain the center. This will also help future investors understand what Id Shaliah will use the money for. Having this is critical as Id Shaliah focuses funding efforts on external organizations that can provide monetary donations, partnerships, or support through grant writing.

Based on our work in Cubuy-Lomas, we would recommend the following to any future researchers working on a remote community resilience project:

**1. We recommend future researchers reach out to possible external aid as early as possible.**

Our team reached out to organizations that could provide funding, donations, or other resources once we arrived in Puerto Rico. This gave us a short eight-week period where we had to wait for responses, follow up with organizations, and try to schedule meetings. This led to our team having a troubling response rate with solar installation and water strategies companies as well as funding organizations. For example, our team reached out to 19 organizations that worked with solar projects, yet we were only able to meet with three of them. Our team received responses up to three weeks after the initial attempt to contact organizations, which is a significant amount of time given the scope of our project and limited our ability to create a relationship between Id Shaliah and the organizations who responded later. Reaching out to contacts as early as possible, ideally even before arriving at the project site, is important for future researchers in order to maximize response rates.

**2. We recommend future researchers create media to inform the community of the work prior to arrival.**

Before our team first travelled to Cubuy-Lomas, we recorded an introductory video and created an informational flyer about our project. Javier Valedón posted both materials to the Id Shaliah Facebook page, which many community members interact with. This gave the community a positive and informed image of our research, built trust, and potentially changed the viewpoint many community members had of us as foreign outsiders. The interviews conducted afterward gave us emotional, detailed stories of community members' past experiences with disasters that they felt comfortable sharing with us. Any researchers working to support a community should provide some form of introduction on their project to ensure a smoother and more successful research process.

### **3. We recommend future researchers utilize a place-based approach to incorporate community feedback.**

A place-based approach encourages close collaboration between researchers and the community members in the area where they perform fieldwork. Incorporating community perspectives throughout the project allowed us to gain a better understanding of what strategies would satisfy the needs of the community. This included meeting with Id Shaliah and community members once we created our vision of the strategies to receive input from those who will actually use the strategies once implemented. Feedback from the community led us to modify the strategies to reflect their wants and our place-based approach. Incorporating feedback from community members and sponsors will lead to more meaningful and effective outcomes.

Due to the vulnerable nature of Cubuy-Lomas, our team developed strategies and provided recommendations to increase the adaptive capacity of the community. Through our team's two-month project, we partnered with a community-based organization to identify and triage needs identified by community members. By reaching out to numerous organizations, we were able to connect an isolated startup organization with external support that can improve their ability to make the community more resilient. We successfully created a partnership for a solar installation at the center, dramatically increasing its adaptive capacity. These external organizations would provide aid to the community center in the form of food, water, supplies, and engineering and economic support for various projects. Additionally, the recommendations for the community center will help to improve the community center's impact on creating a more resilient Cubuy-Lomas.

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## Appendix A: Community Interview Questions

The following interview questions in Appendix A served as a framework for the interviews conducted. Note that we did not follow the exact structure and wording of the questions as we used a semi-structured format that allowed for a conversation to take place between interviewer and interviewee. We asked additional questions based on answers that community members provided during the interviews and to explore topics in greater detail.

### Introduction

Hello, my name is \_\_\_\_\_. I am a member of an undergraduate research team from Worcester Polytechnic Institute in Massachusetts. The purpose of our study is to help improve Cubuy-Lomas's preparedness and response to disasters. If you would be willing, we would like to interview you. There may be some sensitive topics that come up so you are free to withdraw from the interview at any time and any information you are willing to disclose will remain confidential. Also, would you be fine with me recording the audio of the interview?

### **Id Shaliah Staff**

#### Javier Valedón

1. Can you describe the structure of Id Shaliah? Who are the members of the board?
2. Can you describe your typical daily routine at the community center?
3. Can you elaborate on the external money or donations Id Shaliah has received so far, besides aid from TJ Maxx?
4. How do you envision applying to grants for the future with your team?
5. How does the community center obtain water?
  - a. What happens to this supply during a hurricane?
  - b. If there is not sufficient water in disaster times, what are your plans to maintain an adequate supply for the center even during disasters?
  - c. How many people should the water supply serve if needed in a disaster?
6. Does the municipal government help with hurricane preparations for the whole community?
7. Once completed, how will the center obtain power?
  - a. How often do you think the power will go out based on nearby buildings?

- b. What are your plans for power if it goes out for an extended period during and after a disaster?

*Transition: We are now going to speak on Hurricane Fiona and the impacts on your community.*

8. Were any preparations made at your home prior to Hurricane Fiona?
9. Were there any issues with your home during Hurricane Fiona?
10. Can you describe the forms of communication that the community uses during and after a natural disaster?
  - a. Where specifically could there be areas of improvement with these communication networks?
  - b. How do community members reach out to the volunteers during the disaster period and vice versa?
11. What additional resources (besides money) could Id Shaliah benefit from to efficiently respond to future natural disasters?

#### Permanent Staff/Volunteers

1. What is your name (if not met already) + tell us about yourself.
2. What is your home life like?
3. How long have you lived in the Cubuy-Lomas area?
4. How long have you worked with Javier and Id Shaliah?
5. What are your responsibilities at Id Shaliah?
  - a. What does your day-to-day look like at Id Shaliah?

*Transition: We are now going to speak on Hurricane Fiona and the impacts on your community.*

6. Do you have responsibilities with Id Shaliah during and after disasters?
7. What additional resources (besides money) could Id Shaliah benefit from to efficiently respond to future natural disasters?

#### **Community Members**

##### Non-working elderly: Senior community members

1. What is your name? Could you tell us about yourself?
2. How is the community during the day (when everyone is at work)?
3. What is your home life like?

4. How long have you lived in the Cubuy-Lomas area?

*Transition: We are now going to speak on Hurricane Fiona and the impacts on your community.*

5. Were any preparations made at your home prior to Hurricane Fiona (and by whom)?

6. Were there any issues with your home during Hurricane Fiona?

7. Does your power go out? Do you have a backup source?

8. In post-disaster times, what are the challenges that you faced?

9. What additional resources could you and your family potentially benefit from in the wake of future natural disasters?

#### Workers

1. What is your name? Could you tell us about yourself?

a. How long have you lived in the Cubuy-Lomas area?

2. What is your job within the community?

3. What is your home life like?

*Transition: We are now going to speak on Hurricane Fiona and the impacts on your community.*

4. Were any preparations made at your home prior to Hurricane Fiona?

5. Discuss the impacts of Hurricane Fiona on your home and work/business

a. Impacts on home

b. Impacts on work and how long you were out of work for?

6. Does power go out in the community? Do you have a backup source at either home or at work?

7. In post-disaster times, what are the challenges that you faced?

8. What improvements in the community are needed for a more resilient response to the next disaster?

#### **Municipality Workers**

##### Mayor

1. What is your name? Where do you live? Could you tell us about yourself?

2. How long have you been working as a mayor?

3. Could you describe the municipality's actions to prepare for recent natural disasters?

a. Do you know about the work specifically in Cubuy-Lomas?

- b. Based on the impact of recent storms, what do you think the municipality needs to do when preparing for the next disaster?
4. Could you describe what was happening during the storms (Maria and Fiona)?
  - a. How did you communicate with the local leaders?
5. How did the municipality help the people after the storm?
  - a. How did the municipalities communicate with the PR government?
  - b. What type of help did the PR and US governments provide to the municipality for recovery?
  - c. How did you communicate with communities to determine who needed help?
  - d. How long did it take before the responders could drive to Cubuy-Lomas?
6. Did you travel to Cubuy-Lomas after the storm?
  - a. If so, "Could you describe the damage you saw in and around Cubuy-Lomas?"
  - b. If not, "Did you hear any stories about the damage in and around Cubuy-Lomas?"
7. What would you like to see improved for the recovery effort of the next storm?
8. Would it be feasible for the municipality to help with the water storage system?

#### Police Officer

1. What is your name? Where do you live?
2. How long have you been working at the police station?
3. Could you describe the size of the area your station serves? Where is the area that takes the longest to get to?
  - a. If it's not Cubuy-Lomas, how long does it take to get to Cubuy-Lomas?
4. Could you describe what actions the police or the municipality took to prepare for recent natural disasters?
5. Do you know about the work specifically in Cubuy-Lomas?
6. Based on the impact of recent storms, what do you think the police or municipality needs to do when preparing for the next disaster?
7. Do you hand out vouchers, money, generators, or other goods?
8. Could you describe what was happening during the storm (either hurricane)? Was the police station staffed, or was everyone at home?
  - a. If staffed, was the staff able to communicate with any communities in the area?
9. How did the storm impact the police station?

10. After the storm, could you describe the work done by the police towards recovery effort?
11. How did you communicate with communities to determine who needed help?
12. How long did it take before the responders could drive to Cubuy-Lomas?
13. Did you travel to Cubuy-Lomas after the storm?
  - a. If so, could you describe the damage you saw in and around Cubuy-Lomas?
  - b. If no, did you hear any stories from other officers about Cubuy-Lomas?
14. What resources did the station and municipality offer for aid in the recovery effort?
15. What would you like to see improved for the recovery effort of the next storm?

## **Appendix B: External Resiliency Organizations Interview**

### **Questions**

1. Can you discuss the work your organization has done to foster resiliency in Puerto Rico?
  - a. What strategies does your organization use for planning any resilience project?
  - b. What strategies do you often see implemented (Solar? Water collection? Supplies?)
2. What government support are you receiving, if any?
  - a. How are you filling the gaps in the services that the government should be providing?
3. What sources of funding does your organization have currently for Puerto Rico? Do you have grants? Donations?
  - a. If they have grants: can you explain your process for applying?
4. Can you describe how you have been able to maintain successful and meaningful work within the area of resilience?
5. When a resilience hub just starts what should they focus on?
  - a. What is the best way to spread the word of what the resilience hub is doing and get known by people around the community?
6. Have you worked in the past with other resilience hubs?
  - a. How have you contacted them?
  - b. What criteria must a certain resilience hub have for your organization to work or partner with them? If so, what is that criteria?
  - c. How have you collaborated with the other resilience hubs?



Appendix C: Seven-Dimensional Model

Dimension of Inherent Resilience				
1. Ecological	Sub-element	Data Points		
	Resource availability	Vegetation cover	Canopy cover percentage	Water quality
		Soil quality	Air Quality	Water quantity
	Biodiversity	Diversity of species	Diversity of vegetation	Genetic diversity
2. Social	Connectivity	Landscape planning and use	Migration patterns	Landscape connectivity
	Sub-element	Data Points		
	Social support	Volunteer aid	Radio broadcasts	Social cohesion
		Psychological resiliency	Effectiveness of communication platforms	Digital announcement platforms
3. Economic	Social participation	Social embeddedness	Voting participation	Disaster response coordination
		Formal networks (groups and organizations)	Religious groups	Crisis communication protocols
	Demographics	Informal networks (family and friends)	Volunteer groups	Per capita number of groups and associations
		Age	Community roles	Religion
	Sub-element	Gender	Percent vulnerable	Marital staus
		Occupation	Race	
	Level of economic resources	Property value	Education and literacy levels	Business turnover
		Consumption of goods	Subsistence farming	
	Resource equity	Income	Municipal finance/revenues	Corporate and property taxation
	Economic diversity	Wealth disparity	Housing Equity	
		Employment	Job opportunities	Wealth generation

4. Institutional	Sub-element	Data Points		
	Resource allocation & planning	Zoning and building standards Utilization rates of resources	Institutional design that increase responses at a local level	Education systems
	Strategic partnerships & collaborations	Support for vulnerable populations Interoperable communications	Partnership with local colleges to develop resilience models for a community	Public shelters
	Risk management	Community preparedness training programs Mobile phone alerts	Participation in hazard reduction programs Hazard Mitigation Plans	Emergency response plans Emergency Services
5. Infrastructure	Sub-element	Data Points		
	Resource allocation	Continuity of operation plans Cost per unit of resource	Use of generators Budgets	Urbanization Solar panels
	Emergency preparedness	Water supply management Waste management	Physical protection against natural disasters or external shocks Residential housing stock and age	Emergency alert system (EAS) Biosand filters
	System design	Roads, bridges, schools, hospitals Number of transportation networks Housing quality	Energy security Infrastructure design Commercial and manufacturing establishments	Lifelines and critical infrastructure Shelters Quality of transportation networks
6. Community Competence	Sub-element	Data Points		
	Psychological coping strategies	Absence of psychopathologies	Public health	Counseling services
	Knowledge & information	Career mentorship Education	Literacy Access to quality learning materials	Financial literacy
	Skills & capabilities	Entrepreneurship Local understanding of risk	Job creation initiatives	Extracurricular activities
7. Governance & Leadership	Sub-element	Data Points		
	Legal framework		Strategy development	
	Governing organizations	Internal community governance	County government Municipality/City government	State/Province government Federal government
	Community leadership	External governance Farmers organizations	Strong leadership	Civil society activists

## Appendix D: Contact Lists of Support Organizations

### Water Strategies

Organization	Email	Phone	Contact?	Notes
DG Authority	<a href="mailto:dg.authority.pr@gmail.com">dg.authority.pr@gmail.com</a>	(787) 648-9868	Emailed	responded- we called. his company now not relevant but he wants to help and has many engineering friends in US that may have funding sources- sent extensive email detailing project- friends could only help with solar
ProTank	<a href="mailto:sales@protank.com">sales@protank.com</a>	(866) 776-8265	Emailed	followed up 2/1
Advance Water Systems	<a href="mailto:advancewatersystemsinc@gmail.com">advancewatersystemsinc@gmail.com</a>	787-733-1443	Emailed	talked over phone- Hector Negron visited Site- developing system- \$25k quote
Pure Water for the World	<a href="mailto:info@purewaterfortheworld.org">info@purewaterfortheworld.org</a>	802-747-0778	Emailed and rejected	not working in PR
Living Water	<a href="mailto:LivingWaterTrips@water.cc">LivingWaterTrips@water.cc</a>	281-207-7831	Emailed and rejected	No work in PR
Healing Waters	<a href="mailto:info@healingwaters.org">info@healingwaters.org</a>	+1 303 526 7278	Emailed	
Hope International Development Agency	<a href="mailto:hope@hope-international.com">hope@hope-international.com</a>	(866) 525-4673	Emailed	
Mennonite Central Committee (MCC)	<a href="mailto:mailbox@mcc.org">mailbox@mcc.org</a>	(717) 859-1151	Emailed	
Black & Veatch Engg	<a href="mailto:QuinonesAJ@bv.com">QuinonesAJ@bv.com</a>		Emailed and rejected	followed up 2/1- said they had too many projects
IS Drilling Inc.	<a href="mailto:losierra@gmail.com">losierra@gmail.com</a>	787 761-2570	Emailed	Responded- said they can give discount on test well but we have to negotiate- we told them to wait as we assess options (1/31)
Complete Well and Pump	<a href="mailto:prpozos@gmail.com">prpozos@gmail.com</a>	(787) 836-1474	Emailed	Responded- said they would be interested in well - followed up 2/1
Brewster Well Drilling	<a href="mailto:info@brewsterwelldrilling.com">info@brewsterwelldrilling.com</a>	866-482-8880	Emailed and rejected	followed up 2/1 - won't do it as it is just 1 well
Groundwater Foundation	<a href="mailto:info@groundwater.org">info@groundwater.org</a>	800-858-4844	Emailed	
PJ Plumbing	<a href="mailto:services@piplumbingllc.com">services@piplumbingllc.com</a>	787-313-9171	Javier contacted	performed Site visit and gave \$7650 quote for system- explore details more

## Solar Installers

Organization	Email	Phone	Contact?	Notes
Simpliphi	<a href="https://simpliphipower.com/contact-us/">https://simpliphipower.com/contact-us/</a>	805-640-6700	emailed thru website	
Pura Energia	<a href="mailto:info@puraenergiapr.com">info@puraenergiapr.com</a>	787-245-8660	emailed	
Sonnen		939-268-2440	emailed thru website	partner orgs in PR- this is the larger org
Sunnova	<a href="mailto:servicioalcliente@sunnova.com">servicioalcliente@sunnova.com</a>	787-991-7007	emailed	
Golden Solar Tech	<a href="mailto:wmbumba@goldensolartechnologies.co">wmbumba@goldensolartechnologies.co</a>	(787) 796-1096	emailed	meeting 2/1 11AM - said over email after that project too early on for his help
Sun Products	<a href="mailto:info@sunproductspr.com">info@sunproductspr.com</a>	787-200-6165	emailed	followed up 2/1
Empowered By Light	<a href="mailto:info@empoweredbylight.org">info@empoweredbylight.org</a>		emailed	followed up 2/1
Fundacion Comunitaria	<a href="mailto:fcpr@fcpr.org">fcpr@fcpr.org</a>	(787) 721-1037	emailed	
Por Los Nuestros	<a href="mailto:admin@porlosnuestros.com">admin@porlosnuestros.com</a>		emailed	followed up 2/1
Solar Libre	<a href="mailto:solarlibrepr17@gmail.com">solarlibrepr17@gmail.com</a>		emailed	could only donate small portion of roof area after batteries installed by someone else
Resilient Power PR	<a href="mailto:info@resilientpowerpr.org">info@resilientpowerpr.org</a>	(787) 289-9494	emailed	followed up 2/1
Kimbley-Horn Engineering	<a href="mailto:ruth.robles@kimley-horn.com">ruth.robles@kimley-horn.com</a>		emailed	followed up 2/1
Water Mission	<a href="mailto:communications@watermission.org">communications@watermission.org</a>		emailed and rejected	do not provide services in PR anymore; provided links to other potential services
Manage Energy Solution		(787) 404-1095	number invalid	
Cenergys LLC	<a href="mailto:info@cenergyspr.com">info@cenergyspr.com</a>	(939) 717-3916	emailed	
Uriel	<a href="mailto:uriel@urielinversiones.com">uriel@urielinversiones.com</a>	512-394-5580	emailed	followed up 2/1
TSK	<a href="mailto:grupotsk@grupotsk.com">grupotsk@grupotsk.com</a>	+34 984 49 55 00	emailed	followed up 2/1
Altenergy	<a href="mailto:ESTIMATES@ALTENENERGY.US">ESTIMATES@ALTENENERGY.US</a>	(844) 654-9346	emailed	



## Funding Organizations and Partnerships

Organization	Email	Phone	Contact?	Notes
Global Communities	<a href="mailto:mmclaughlin@globalcommunities.org">mmclaughlin@globalcommunities.org</a>	858-279-9690	Emailed and rejected	do not work in PR
Fundación Comunitaria	<a href="mailto:fcpr@fcpr.org">fcpr@fcpr.org</a>	787-721-1037	emailed	
Adventist Development and Relief Agency (ADRA)		1-800-424-2372	emailed on website	
CAMA	<a href="mailto:cama@camaservices.org">cama@camaservices.org</a>	(380) 208-6152	emailed	
Convoy of Hope		417-823-8998	emailed on website and rejected	do not work in PR
Engineering Ministries International	<a href="mailto:info.us@emiworld.org">info.us@emiworld.org</a>	719-633-2078	emailed	
Energy for Mission	<a href="mailto:info@energyformission.org">info@energyformission.org</a>	512-971-2364	emailed	
Healing Hands International		<a href="tel:615-832-2000">615-832-2000</a>	emailed on website and rejected	Do not do in country work unless it's disaster
Operation Blessing		<a href="tel:800.730.2537">800.730.2537</a>	emailed on website	
Red Cross			emailed on website	responded - referred to regional office who will contact us
IEM		<a href="tel:(787)417-7220">(787) 417-7220</a>	emailed on website	

## External Resiliency Organizations

Organization	Phone	Email	Status	Notes
ResilientSEE		<a href="mailto:Yanel.deAngel@perkinswill.com">Yanel.deAngel@perkinswill.com</a>	Met with	said they wanted to help Javier; we provided documents but have not heard back as of end of project
Plenitud PR	787-221-2646	<a href="mailto:info@plenitudpr.org">info@plenitudpr.org</a>	Emailed, called, met with	takeaways in report
ViequesLOVE	787-435-3172	<a href="mailto:info@viequeslove.org">info@viequeslove.org</a>	Uncontacted	
COREFI Vieques	787-905-6946	<a href="mailto:COREFI00765@GMAIL.COM">COREFI00765@GMAIL.COM</a>	Uncontacted	
Faith That Transforms	787-308-5659 or 939-545-0049	<a href="mailto:fequetransforma@gmail.com">fequetransforma@gmail.com</a>	Met with	takeaways in report
Hispanic Federation		<a href="mailto:prinfo@hispanicfederation.org">prinfo@hispanicfederation.org</a>	Met with	takeaways in report
La Corporación Piñones Se Integra (COPI)	787-253-9707	<a href="mailto:copilpr@gmail.com">copilpr@gmail.com</a>	Contacted - told us to call back	Never met
Pinones Aprende Y Emrende (PAYE)	939-223-3803	<a href="mailto:p.aprendeyemrende@gmail.com">p.aprendeyemrende@gmail.com</a>	Uncontacted	
Comité Desarrollo Social y Cultural Dagua	(787) 874 - 4444		Uncontacted	No resilience programs, does have volunteer programs
Guardarraya Unidos Por un Patrimonio Educativo Inc.		<a href="mailto:comitegupe@gmail.com">comitegupe@gmail.com</a>	Uncontacted	
G-8 Cano Martin Pena	(787) 946-3394	<a href="mailto:g-8inc.pr@hotmail.com">g-8inc.pr@hotmail.com</a>	Uncontacted	
Comite Comunal Corcovada, Inc.	787-473-0528	<a href="mailto:comite.corcovada@gmail.com">comite.corcovada@gmail.com</a>	Uncontacted	No resilience programs
Asociacion de Comunidades Unidas Tomando Accion Solidaria	(787) 985-9930	<a href="mailto:acutaspr@gmail.com">acutaspr@gmail.com</a>	Uncontacted	No resilience programs, does have solar
Programa de Educacion Comunal de Entrega y Servicio (P.E.C.E.S., INC.)	(787) 595-8239	<a href="mailto:admin@proyectopecesinc.org">admin@proyectopecesinc.org</a>	Uncontacted	Planning to build resiliency hub
Foundation for Puerto Rico	787-773-1100	<a href="mailto:info@foundationpr.org">info@foundationpr.org</a>	Contacted	
CONPRMETIDOS	787-637-4335		Contacted through site	
UREX sustainability network			Contacted	
Stronger Than		<a href="mailto:info@wearestrongerthan.org">info@wearestrongerthan.org</a> < <a href="mailto:info@wearestrongerthan.org">info@wearestrongerthan.org</a> >;	Contacted	
For such a time as this		<a href="mailto:info@forsuchathimeasthispr.org">info@forsuchathimeasthispr.org</a> < <a href="mailto:info@forsuchathimeasthispr.org">info@forsuchathimeasthispr.org</a> >;	Planned to meet- never showed	
One Stop Career PR			Contacted - Heard back	They will forward information to the correct person in their organization
Vitrina Solidaria	787-690-7272	<a href="mailto:info@vitriinasolidaria.org">info@vitriinasolidaria.org</a> < <a href="mailto:info@vitriinasolidaria.org">info@vitriinasolidaria.org</a> >;	Uncontacted	JM recommended b/c close to Javier (unknown distance)

## **Appendix E: Community Communication and Outreach Plan**

### **Outreach Plan Guidelines**

#### **Things to do (Javier/Id Shaliah):**

1. Assign a neighbourhood leader to each of the 24 sectors in Cubuy-Lomas.
2. Provide the neighbourhood leaders with the hurricane preparation checklist, hurricane preparedness questionnaire, and the community center informational flyer.
3. Have Id Shaliah post the hurricane preparation checklist and community center informational flyer to their social media pages.
4. Based on the neighbourhood leaders' evaluations, give them the necessary supplies requested.

#### **Things to do (Neighbourhood Leaders):**

1. At the start of hurricane season, distribute the hurricane preparation checklist and Community Center flyer to houses and frequently visited spots such as grocery stores and elderly center.
2. At the start of the hurricane season, talk to a house member in the assigned sector and collect information based on the start of the hurricane season questionnaire.
3. Report the information to Id Shaliah and identify the most vulnerable population/houses.
4. Collect the resources and distribute to the people who need it.
5. Right before a hurricane, talk to the vulnerable population/houses in the assigned sector and collect information based on the right before hurricane questionnaire. Also, quickly check-up on the non-vulnerable population/houses.
6. Report the information to Id Shaliah and collect the necessary resources and distribute to the people who need it.

#### **Note:**

- If possible, supply Id Shaliah and neighbourhood leader with long-distance radios for communication during the storm



## Questionnaire for Assessing Disaster Preparedness in Houses

\*Make sure to get the address of the house and the name of the person answering the questions\*

\*Record the answers of the people answering the questions\*

### **Start of Hurricane Season:**

1. Do you have extra food stored?
2. For how many people and how many days?
  - a. Do you have extra water stored?
  - b. For how many people and how many days?
3. Do you have a backup source of power?
4. Is your house made of concrete?
5. Do you have windows that need to be boarded up?
6. Do you have an evacuation plan if needed in case of an emergency?
7. Do you have an alternative way to communicate with people you're close to if cell service is unavailable?

### **Right Before Hurricane:**

1. How many people are you staying with?
2. How much food is there stored for all of you?
3. How much water is stored for all of you?
4. Do you have backup source of power? If yes, what kind?
  - a. If a generator, do you have enough gasoline to run it, and for how long?
  - b. If no backup source, do you have an alternative source of light such as candles or flashlights and how many?
5. Do you need help boarding up the windows in your house?

## Cuestionario para evaluar la preparación para desastres en las viviendas

\*Asegúrese de obtener la dirección de la casa y el nombre de la persona que responde las preguntas\*

\*Registre las respuestas de las personas que respondieron las preguntas\*

### **Inicio de la temporada de huracanes:**

1. ¿Tienes alimentos extra almacenados?
2. ¿Para cuántas personas y cuántos días?
  - a. ¿Tienes agua extra almacenada?
  - b. ¿Para cuántas personas y cuántos días?
3. ¿Tienes una fuente de energía de respaldo?
4. ¿Tu casa es de hormigón?
5. ¿Tienes ventanas que necesitan taparse con tablas?
6. ¿Tienes un plan de evacuación si es necesario en caso de una emergencia?
7. ¿Tienes una forma alternativa de comunicarse con las personas cercanas si el servicio celular no está disponible?

### **Justo antes del huracán:**

1. ¿Con cuántas personas te quedas?
2. ¿Cuánta comida hay almacenada para todos ustedes?
3. ¿Cuánta agua se almacena para todos ustedes?
4. ¿Tienes una fuente de energía de respaldo? Si es así, ¿de qué tipo?
  - a. Si es un generador, ¿tiene suficiente gasolina para hacerlo funcionar y por cuánto tiempo?
  - b. Si no hay una fuente de respaldo, ¿tiene una fuente de luz alternativa, como velas o linternas, y cuántas?
5. ¿Necesita ayuda para tapar las ventanas de tu casa?

## **Appendix F: Funding Strategic Plan**

Id Shaliah is a young nonprofit organization that aims to create absolute autonomy to supply the needs of the Cubuy-Lomas community through a central hub that provides accessible services to all citizens. The goal of our initiative is to build a stronger, united, and prosperous community.

In order to achieve its mission, Id Shaliah needs to secure a robust and diverse funding base. This strategic plan outlines the goals, strategies, tactics, and metrics for five distinct funding sources:

- (1) Grant Writing
- (2) Crowdfunding
- (3) Corporate Sponsorships
- (4) Fundraising Events
- (5) Individual Donations

### **Goals:**

1. Secure funding to support Id Shaliah's programs and operations once the community center opens.
2. Diversify Id Shaliah's funding base to reduce reliance on any single funding source and increase sustainability and resilience.
3. Build long-term relationships and partnerships with key funders and donors that share Id Shaliah's values and mission.
4. Increase awareness and visibility of Id Shaliah's work and impact among the philanthropic community and throughout Cubuy-Lomas.

### **Strategies and Tactics:**

The following section overviews potential strategies and tactics that may be used to obtain funds. The Excel document contains a generalized cost-benefit analysis of the five funding sources.

#### **1. Grant Writing:**

**Goal:** Secure at least five grants per year from government, foundation, and corporate sources that align with Id Shaliah's priorities and programs.

- Strategy: Develop a targeted and compelling grant proposal that highlights Id Shaliah's strengths, impact, and alignment with the funder's priorities and requirements.
- Tactics:
  - Research and identify potential grant opportunities that fit Id Shaliah's mission and priorities.
  - Develop a grant proposal template and customize it for each grant opportunity.
  - Engage with funders and build relationships through networking, follow-up, and impact reporting.
  - Monitor and evaluate the grant-funded programs and report the results to the funders.

## 2. Corporate Sponsorships

**Goal:** Secure at least two corporate sponsorships per year that provide significant funding and other types of support to Id Shaliah's programs and operations.

- Strategy: Develop a partnership proposal that demonstrates the mutual benefits and value of the collaboration between Id Shaliah and the corporate sponsor.
- Tactics:
  - Research and identify potential corporate sponsors that share Id Shaliah's values and mission.
  - Develop a partnership proposal that outlines the scope, goals, and benefits of the collaboration, as well as the expected responsibilities and resources of both parties.
  - Engage with corporate sponsors and build relationships through networking, follow-up, and impact reporting.
  - Implement the partnership activities and evaluate the results.

## 3. Fundraising Events

**Goal:** Organize at least three fundraising events per year that generate significant revenue and engage donors and supporters.

- Strategy: Develop a diverse and creative portfolio of fundraising events that appeal to different audiences and meet different fundraising goals.
- Tactics:
  - Identify the types of fundraising events that are feasible, effective, and aligned with Id Shaliah's mission and audience, such as galas, auctions, walks, runs, or concerts.
  - Develop a detailed plan for each fundraising event that includes the goals, timeline, budget, marketing, logistics, and volunteer recruitment.
- Recruit and train volunteers to help with the planning, execution, and follow-up of the fundraising events.
- Promote fundraising events through multiple channels, such as social media, email, website, and word-of-mouth.
- Evaluate the success of each fundraising event based on the revenue generated, the number and quality of donors and supporters engaged, and the feedback and lessons learned.

#### 4. Crowdfunding

**Goal:** Launch at least one crowdfunding campaign per year that raises significant funds and attracts new donors and supporters.

- Strategy: Develop a compelling and authentic crowdfunding campaign that tells Id Shaliah's story, mission, and impact in a compelling and emotional way.
- Tactics:
  - Identify the crowdfunding platform that best fits Id Shaliah's needs and audience, such as Kickstarter, Indiegogo, GoFundMe, or Mightycause.
  - Develop a crowdfunding campaign that includes a clear and specific goal, a detailed budget, a timeline, and a range of donation levels and rewards.
  - Create a video or other multimedia content that showcases Id Shaliah's work and impact and inspires donors to contribute.
  - Promote the crowdfunding campaign through multiple channels, such as social media, email, website, and personal networks.

- Engage with donors and supporters during and after the crowdfunding campaign and provide regular updates and impact reports.

## **5. Individual Donations**

**Goal:** Build a loyal and engaged base of individual donors who contribute regularly and provide significant funds and other types of support to Id Shaliah's programs and operations.

- Strategy: Develop a donor cultivation and stewardship program that emphasizes donor relationships, communication, recognition, and impact.
- Tactics:
  - Identify the types of individual donors that are most likely to support Id Shaliah's mission and priorities, such as previous donors, volunteers, board members, or personal contacts.
  - Develop a donor database that includes the donor's contact information, giving history, preferences, and interests.
  - Develop a donor communication plan that includes regular and personalized messages, updates, impact reports, and opportunities for engagement and feedback.
  - Recognize and thank donors in meaningful and personalized ways, such as personalized letters, phone calls, invitations, or recognition events.
  - Monitor and evaluate the donor engagement and retention rates and adjust the strategies and tactics accordingly.

### **Metrics and Evaluation:**

1. Grant Writing: Number of grants secured, amount of funding received, success rate, and impact evaluation.
2. Corporate Sponsorships: Number of corporate sponsorships secured, amount of funding and other types of support received, success rate, and impact evaluation.
3. Fundraising Events: Revenue generated, number and quality of donors and supporters engaged, return on investment, and impact evaluation.

4. Crowdfunding: Amount of funds raised, number and quality of donors and supporters engaged, success rate, return on investment, and impact evaluation.
5. Individual Donations: Amount of funds raised, number and quality of donors and supporters engaged, donor retention rate, return on investment, and impact evaluation.

### **Summary of Cost-benefit Analysis:**

1. Grant Writing:
  - Pros: Grants are a great way to obtain funds quickly and efficiently, and the application process is often straightforward and clear.
  - Cons: Grants can be highly competitive and difficult to obtain, and there may be many restrictions on how the money can be used.
2. Crowdfunding:
  - Pros: Crowdfunding is a relatively easy way to raise money, and it can attract a wide variety of donors.
  - Cons: Crowdfunding campaigns can be difficult to manage and often require a lot of time and effort to be successful.
3. Corporate Sponsorship:
  - Pros: Corporate sponsorships can provide a steady stream of income, and many companies are willing to donate funds to non-profit organizations.
  - Cons: Depending on the company, the terms of the sponsorship may be restrictive and not beneficial to the organization.
4. Fundraising Events:
  - Pros: Fundraising events can be a lot of fun and can generate a lot of buzz for the organization. They also provide an opportunity to engage with potential donors.
  - Cons: Organizing and executing a successful fundraising event takes a lot of time, effort, and money.
5. Individual Donations:
  - Pros: Individual donations are typically small, but they can quickly add up to a significant amount of money.
  - Cons: Relying on individual donations can be unpredictable and require a lot of outreach and marketing to find potential donors.



## **Conclusion:**

This strategic plan outlines a comprehensive and integrated approach to fundraising that leverages the strengths and opportunities of multiple funding sources, including grant writing, corporate sponsorships, fundraising events, crowdfunding, and individual donations. By diversifying the funding portfolio, Id Shaliah can mitigate the risks and challenges of relying on a single source of funding and tap into a wider range of resources, networks, and supporters.

However, to implement this strategic plan successfully, Id Shaliah needs to invest in the necessary resources, capacities, and systems, such as skilled staff, efficient processes, and reliable data management. Id Shaliah also needs to prioritize transparency, accountability, and impact measurement in its fundraising practices to build trust and credibility with its donors, supporters, and stakeholders.

Overall, this strategic plan is not only about generating funds but also about building relationships, awareness, and impact that are crucial for Id Shaliah's long-term sustainability and growth. By following this plan, Id Shaliah can realize its vision of Id Shaliah is a young nonprofit organization that aims to create absolute autonomy to supply the needs of the Cubuy-Lomas community through a central hub that provides accessible services to all citizens. The goal of our initiative is to build a stronger, united, and prosperous community.

Funding Method	Benefit(s)	Drawback(s)
Grant Writing	Grants can provide a significant source of funding for non-profit organizations, which may be especially important for a young organization that is still building its donor base or fundraising capacity.	Grant writing can be a time-consuming and labor-intensive process, especially for organizations that are still small or understaffed.
	Grant funding can help non-profit organizations pursue specific projects or initiatives that align with their mission and goals.	Grant applications may require a level of technical expertise or experience that a young organization may not have, such as knowledge of financial reporting or program evaluation.
	Grant applications often require non-profit organizations to articulate their mission, values, and goals, which can be a useful exercise for a young organization that is still developing its identity and direction.	Competition for grants can be fierce, and many organizations may apply for the same funding opportunities, making it challenging for a young organization to stand out.
	The grant application process may provide networking opportunities and connections to potential partners, funders, or supporters that could benefit the organization in other ways.	Grants may come with specific requirements or restrictions that may not align with an organization's mission or goals, or may limit its ability to pursue other funding or growth opportunities.
Crowdfunding	Crowdfunding can provide a quick and relatively easy way to raise funds for a specific project or initiative.	Crowdfunding campaigns can be unpredictable and may not always meet their funding goals, leaving non-profit organizations without the resources they need.
	Crowdfunding campaigns can help non-profit organizations build awareness and support for their cause among a broad base of donors and supporters.	Crowdfunding platforms typically charge fees for their services, which can reduce the amount of funding that non-profit organizations ultimately receive.
	Crowdfunding platforms often provide tools and resources to help non-profit organizations set up and promote their campaigns effectively.	Crowdfunding campaigns require a significant amount of time and effort to plan, promote, and manage, which may not be feasible for a small or understaffed organization.
	Crowdfunding can provide an opportunity for non-profit organizations to engage with their supporters and build a sense of community around their cause.	Crowdfunding campaigns may not be appropriate or effective for all types of non-profit organizations or projects, and may not align with an organization's overall fundraising strategy.
Corporate Sponsorship	Corporate sponsorships can provide significant funding for non-profit organizations, often in the form of a single large donation or multi-year commitment.	Corporate sponsorships can provide significant funding for non-profit organizations, often in the form of a single large donation or multi-year commitment.
	Corporate sponsors may provide other types of support or resources, such as volunteer time or expertise, that can benefit the non-profit organization beyond the funding itself.	Corporate sponsors may provide other types of support or resources, such as volunteer time or expertise, that can benefit the non-profit organization beyond the funding itself.
	Corporate sponsors can help non-profit organizations build credibility and visibility, as well as access to new audiences and networks.	Corporate sponsors can help non-profit organizations build credibility and visibility, as well as access to new audiences and networks.
	Corporate sponsorships can provide a way for non-profit organizations to align themselves with socially responsible companies or brands that share their values and mission.	Corporate sponsorships can provide a way for non-profit organizations to align themselves with socially responsible companies or brands that share their values and mission.
Fundraising Events	Fundraising events can provide a way for non-profit organizations to engage with their supporters and build a sense of community around their cause.	Fundraising events can be expensive and time-consuming to plan and execute, especially for small or understaffed organizations.
	Fundraising events can be a fun and enjoyable way for donors to support the non-profit organization, which may encourage more giving.	Fundraising events may not always generate significant revenue for the non-profit organization, especially if attendance is low or expenses are high.
	Fundraising events can provide opportunities for non-profit organizations to showcase their work, mission, and impact to potential supporters and partners.	Fundraising events may not be feasible or effective during certain times or circumstances, such as during a pandemic or in an area with limited resources or infrastructure.
	Fundraising events can help non-profit organizations diversify their fundraising portfolio and reach new donors who may not have been aware of their cause before.	Fundraising events may not align with an organization's overall fundraising strategy or priorities, and may be better suited for certain types of non-profit organizations or causes than others.
Individual Donations	Individual donors can provide a reliable and sustainable source of funding for non-profit organizations, especially if they are committed to the cause and give regularly.	Relying too heavily on individual donors can be risky for non-profit organizations, as donors may reduce their giving or stop altogether due to changes in their own financial situation or priorities.
	Individual donors can be a powerful advocacy force for the non-profit organization, spreading the word about their mission and impact to their networks and communities.	Cultivating and maintaining relationships with individual donors can be time-consuming and require a significant investment of resources, especially for small or understaffed organizations.
	Individual donors may be more likely to give to a non-profit organization that they feel a personal connection to or a sense of ownership over, such as a locally-based or community-focused organization.	Individual donors may have different expectations or ideas about how their funding should be used, which can create tension or conflict between the donor and the non-profit organization.
	Individual donors can provide feedback and input on the non-profit organization's work and direction, helping to shape its strategy and impact over time.	Individual donors may not be as visible or high-profile as other types of funders, which can limit the non-profit organization's exposure and influence in the broader philanthropic community.