

RESILIENCY FRAMEWORK OF RESIDENTS IN FLOOD PRONE AREAS**Abella, KC Ann Neljane*****Cahigas, Edmar Gwen*****Casilao, Lucelle*****Diola, Ric Beryl******Otero, Yllor James******Piedad, Mc Cloyd****

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ABSTRACT

Floods are one of the most significant environmental problems today. Its consequences range from household, public health, socio-economic, and human life. Incidents of flooding across the globe have caused massive displacement of people into temporary shelters and housing because floods have completely wiped out their homes. Many houses are also left devastated or damaged, yet oftentimes, people return to their homes as if nothing had happened. They instead fortify them and build resiliency for future floods. This study explored the reasons why people choose to stay and rebuild their homes after floods rather than moving into new homes. It utilized an Exploratory Factor Analysis (EFA) to investigate the resiliency framework of inhabitants residing in places at risk of flooding in Davao City. The results revealed that a range of practical, emotional, and personal factors led to their persistence in staying in their own homes even after flash floods. The results also showed that building resilience against floods was dependent on their confidence in themselves and their ability to handle situations and remain optimistic despite hardship. Another factor of why people choose to stay in their homes after these incidents is because of their belief that the effects are temporary, and they can always rebuild and reinforce their homes to mitigate its effects in future incidents. Urban planners and development worker must take into consideration the perspective of residents and their proximity to emergency and essential services upon creating plans for residential development.

Keywords:

Resiliency, flood, disaster

INTRODUCTION

Floods have become an evident global issue as they have caused widespread destruction of property, loss of life, and various environmental and socio-economic impacts (Glago, 2021). It is defined as the overflow of water into dry land, which is often brought about by excessive rainfall and the overflow of rivers and streams. Floods develop swiftly compared to many natural disasters (Habitat for Humanity, n.d). They can incapacitate essential establishments such as hospitals and wipe out houses and properties, negatively impacting livelihood and human life.

One of the major causes of floods is the clogging of waterways. Plastic waste can clog waterways and drainage systems, preventing water from passing through. During intense thunderstorms and heavy rains, rainwater cannot easily flow into drainages because plastic bags, threads, and bottles obscure the water flow. (Marsh, 2023). Two hundred eighteen (218) million globally, or 3% of the global population, are at risk of plastic-aggravated flooding globally, as this leaves urban-poor communities vulnerable to health-related issues from flooding such as leptospirosis, various skin and gastrointestinal infections, and insect-borne diseases such as dengue (Tearfund, 2023).

In 2005, 1000 people were killed after a severe plastic-induced flooding in Mumbai, India. Upon further study, it was discovered that the flood was mainly caused by plastic bags clogging storm drains, preventing flood water from draining out of the city (McVeigh, n.p). A similar incident occurred in Louisiana, USA, in 2005 when Hurricane

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Katrina ravaged the state and submerged approximately 80% of New Orleans in floodwater. Katrina was classified as a Class 3 storm and brought in a 19-foot storm surge that ravaged the city, took over 1,800 lives, and caused over \$100 billion in property damage (Ambrose, 2021). In addition, the flooding brought by the hurricane displaced around a million residents and damaged around a million homes across five states (Richardson, 2021).

Flooding has always been an evident problem in the Philippines. In 2013, Super Typhoon Yolanda ravaged the Eastern Visayas Region. Bringing with it 315/kph wind at landfall, it was the strongest cyclone to ever hit the country in its history. In the aftermath of the super typhoon, 12,270 structures were destroyed entirely in Tacloban, Leyte alone, while 46,553 were partially damaged. Residents reported seeing dead bodies swept away by the flood scattered across the city, as well as floating cars and even an oceangoing freighter being brought inland by floods (Athawes, 2018). The most recent incident of intense flooding in the Davao Region was in February 2024, when around 97,000 families were displaced after landslides, and flooding battered the region. Aside from families being displaced, the flooding also damaged thousands of homes and disrupted the delivery of essential services such as medical assistance and water supply (Save The Children, 2024).

Furthermore, in Davao City, the problem of street and urban flooding across the city is very much evident. Concurrent with the flooding in the nearby provinces in February 2024, the city also experienced its issues with flooding, displacing around 8000 residents from 15 barangays across the city, and search and rescue operations had to involve rubber boats in evacuating people from flooded areas to safer ground, as flood water reached neck-deep depths (Relator, 2024). Also, clogged drainages were seen to cause street flooding across the city, with many areas being submerged in flood water, putting the lives and livelihood of residents at risk (Llemit, 2021).

However, despite this, many residents refuse to leave their homes for safer ground. Often, once floods subside, people eventually return to their homes and do it all over again in future flooding events (Reichel, 2018). Many studies have tackled such topics. A study by Ahsan et al. (2016) stated that people refused to move away from their homes in coastal areas because they did not have enough resources to move and migrate. Many also refuse to migrate away from their homes due to personal, cultural, and economic reasons. However, they would rather invest in emergency planning to mitigate the negative impacts of flash flooding on their homes and properties (Agnimitra et al., 2017).

In response to this, the concept of flood resilience was introduced. Flood resilience involves strengthening how a community responds to floods by identifying and implementing mitigation measures to reduce the impact of flooding on households and communities (Department of Environmental Conservation, n.d). People have also employed structural means such as reinforcing their homes against damage due to floods (Abbey et al., 2020). There is an urgent need to tackle and discuss the flood resilience of residents of Davao City as awareness needs to be spread on how people are affected by flash flooding in the city and how residents adapt to such incidents.

OBJECTIVES

Generally, this study aims to explore the resiliency framework of the residents living in flood prone areas and understand what factors affect them to remain in their homes after the destruction of a natural disaster such as flood. Furthermore, the findings of the study aim to help the population of Davao City, especially those living in flood-prone areas, in developing a framework exploring the factors in building resilience against the impact of flooding and look into the measures they have undertaken to do so. It will also help guide the local government to create policy intervention programs that would address the concerns of residents regarding this issue.

REVIEW OF RELATED LITERATURE

Floods are one of the most common natural hazards globally, displacing millions and causing significant economic damage. As climate change intensifies, flood events are expected to become more frequent and severe. Building resilience in flood-prone communities is crucial to mitigate these impacts. The Philippines is a disaster prone country making the Filipino community geographically, economically, and physically vulnerable (Usamah, et. al., 2014). On average, at least 20 typhoons hit the country each year, with Typhoon Haiyan in 2013 being the strongest to ever hit. Over 14 million people across the country were displaced and suffered the effect of the said disaster. The devastation of Typhoon Haiyan is only one of the hundreds of instances of natural disasters that shake the Filipino community and challenge their resiliency.

As such, Filipinos have to be prepared should disasters like typhoons, flash floods, and landslides happen. However, data shows that only a third of the Filipino population conduct preparedness measures for natural calamities

(Bollettino, et., al., 2020). In the same light, the study reported that Filipinos undertake some forms of training programs for disasters, joined evacuation drills, prepared emergency kits and emergency food and supplies, had tied ropes on their homes, and monitored weather conditions and typhoon warnings. Despite these preparations, factors such as the family's composition, socio-economic status, experiences of previous calamities, determine their decision to evacuate at the onset of the disaster (Medina & Moraca, 2016). Households with children under five years old are likely to evacuate as well as those families that have experienced previous deeper floodings. In the study of Sapalo (2021), families living in flood-prone areas perceive their home as a place that they own, a space for homemaking, and an investment. This constructed idea of 'home' prevents the evacuation and relocation of families despite being affected by natural calamities.

On the other hand, research shows that family, support, religion, and cultivation of emotional strength are key factors in Filipinos being resilient in times of adversity (Dela Cruz, et., al., 2014). A study in two rural barangays in the Philippines revealed that social relationships strengthen the community's resilience in times of natural calamities (Usamah, et. al., 2014). The robust social relationship shapes the community's perception that disasters are a part of their life and the acceptance that their community is always vulnerable to natural calamities, thus making them resilient to the disasters that affect them.

On estimates, Filipinos are revealed to suffer from poverty due to natural disasters. Aside from asset losses, Filipinos also lose their wellbeing when struck by a calamity. The study of Walsh and Hallegate (2020) found that the post-disaster interventions and adaptive social protections help improve Filipino's wellbeing and make them more resilient. Similarly, in a resiliency investigation on communities affected by flash floods and landslides, the study showed that external assistance enables vulnerable households to recuperate from the calamity and attain stability post-disaster (Villano, et. al., 2020).

Developing community resilience is widely acknowledged as crucial for managing disaster risks, given the rise in extreme weather events like floods. These events have disrupted economies, caused substantial losses, displaced populations, and endangered the sustainability of communities worldwide (Oladokun & Montz, 2019). Key international policies, such as the United Nations International Strategy for Disaster Reduction's (UNISDR) 2015 Strategic Framework and the 2005 Hyogo Framework, have stressed and adopted resilience principles in disaster risk management (Cai et al., 2018; Cutter et al., 2016).

The interplay of extreme floods, population growth, and rapid urbanization has heightened flood hazard risks, rendering traditional flood risk management (FRM) measures like concrete structures, levees, flood walls, and other defenses inadequate and unsustainable across communities (Oladokun & Montz, 2019). Resilience has garnered significant attention in policy and research realms, focusing on understanding and addressing land use challenges, vulnerability, and sustainability in the context of flooding. Building community resilience is particularly pertinent in dealing with floods, which are the most prevalent and damaging natural hazards globally (Oladokun & Montz, 2019). The existing literature explores the varying factors as to why and how individuals remain resilient before, during, and post disaster (Bollettino, et., al., 2020, Usamah, et. al., 2014, Villano, et. al., 2020). However, little literature is available underlying the resiliency framework of individuals affected by calamities especially those who are living in flood prone areas.

METHODOLOGY

This study used Exploratory Factor Analysis (EFA) to investigate the resiliency framework of inhabitants residing in places at risk of flooding. 149 respondents residing in Davao City's neighborhoods that were prone to flooding participated in the survey. Researchers conducted a comprehensive assessment of the study instrument used to collect the data in order to guarantee its content validity. The study used EFA to determine the underlying variables influencing the resilience of inhabitants living in flood-prone areas. The dataset was found to be suitable for factor analysis when the strength of partial correlations between variables was evaluated using the Kaiser-Meyer-Olkin criterion of sampling adequacy. The coherence of the correlation matrix was verified using Bartlett's test of sphericity, which validated the relationships between the variables.

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RESULTS AND DISCUSSION

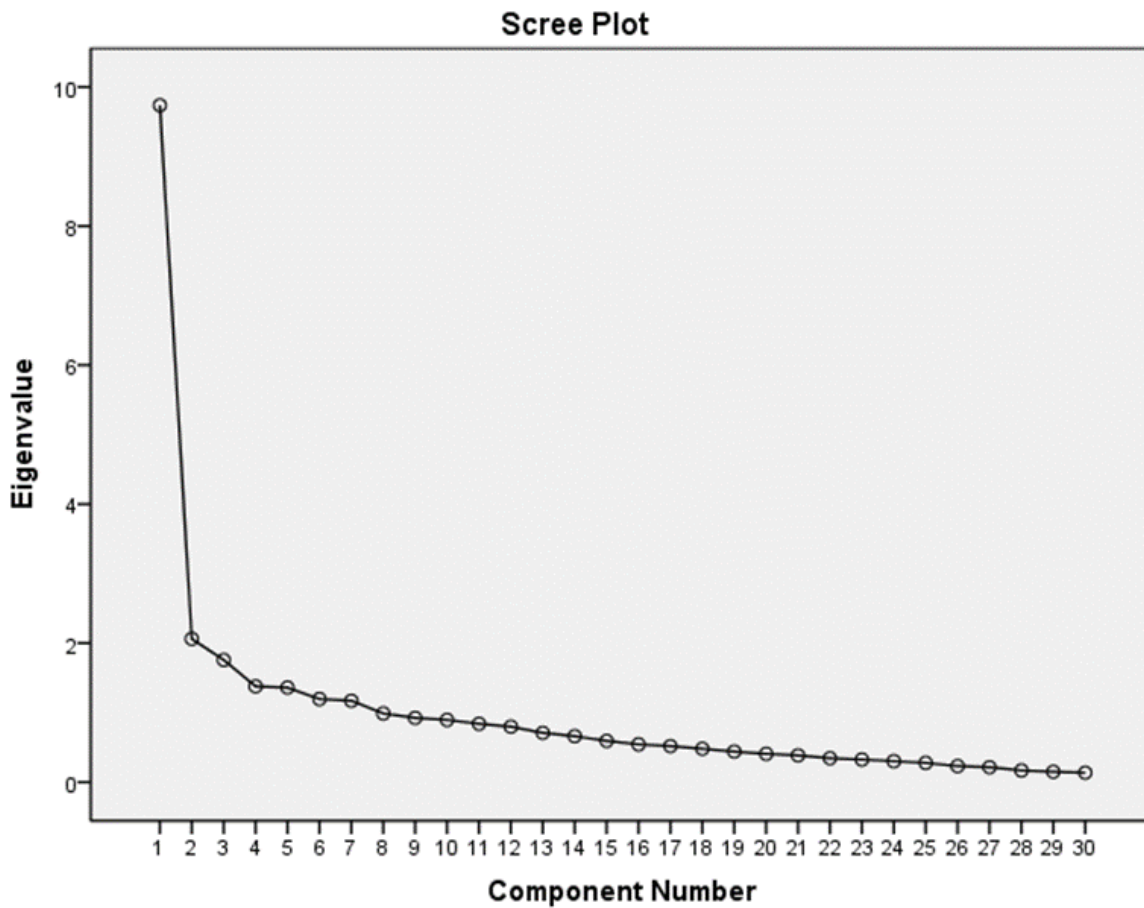
The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) is 0.843, indicating a high degree of sampling adequacy. Survey results meet the suggested criterion of 0.6 or higher, which indicates it is appropriate for factor analysis. An estimated chi-square value of 2107.530 with 435 degrees of freedom was obtained by the Bartlett's Test of Sphericity, resulting in a significant p-value of .000.

The metrics show a significant relationship between the variables, supporting the use of factor analysis.

KMO and Bartlett's Test

| | | |
|---|---------------------------|-----------------|
| <i>Kaiser-Meyer-Olkin Measure of Sampling Adequacy.</i> | | <i>.843</i> |
| <i>Bartlett's Test of Sphericity</i> | <i>Approx. Chi-Square</i> | <i>2107.530</i> |
| | <i>Df</i> | <i>435</i> |
| | <i>Sig.</i> | <i>.000</i> |

Figure 1. Scree Plot



The graph comparison between Eigenvalues and components is shown in the figure above, indicating the relevance of each component. The scree plot exhibits an ideal pattern of a straight line, a bend, and a steep curve in succession. This scree plot illustrates that after the seventeenth component, the eigenvalues begin to form a straight line.

Consequently, the remaining components contribute to very little of the variability and are probably insignificant. The number of factors extracted before the curve flattens shows the significant number of factors taken from the investigation and is described in the component matrix.

Table 1. Grouped Attribute Related to Reluctance to Move

| <i>Factors</i> | <i>Attributes</i> | <i>Loadings</i> |
|---------------------------|--|-----------------|
| <i>Reluctance to Move</i> | <i>Item 14. We have no other place to relocate to.</i> | <i>.747</i> |
| | <i>Item 9. Our house has sentimental value because it's an inheritance from our parents.</i> | <i>.704</i> |
| | <i>Item 8. Our livelihood is here.</i> | <i>.698</i> |
| | <i>Item 11. We are members of this community in this place, and we would feel regretful to move.</i> | <i>.696</i> |
| | <i>Item 3. We cannot leave our house because this is our investment.</i> | <i>.608</i> |
| | <i>Item 12. Our children study here now.</i> | <i>.608</i> |
| | <i>Item 13. We'll just have to embrace the flood as a trial given by God.</i> | <i>.568</i> |

Table 1 shows that attributes 3,8,9,11,12,13 and 14 have contributed to their reluctance to move from their current location with a loading of .747,.704,.698,.696,.608 and .568 respectively.

Item 14 which has the highest loading of .747 suggests that feeling like there are no viable alternative places to move is strongly associated with reluctance to move. Item 14 which has the lowest loading of .568 that while contributing to reluctance to move is less strongly associated compared to the other factors.

Place attachment refers to the connection between an individual to a location or physical environment as defined by De Dominicis et al(2015). Under stressful conditions, it might affect a person's intention to prepare as well as risk mitigation habits. It is a complex social driver in terms of risk mitigation, because it is linked to the emotional judgment of people who are at risk.

Despite the vulnerability of their housing and coastal location, poor residents opt to stay amidst the impending disaster to protect limited possessions; a symbol of their "life's work and sacrifices". life's work and sacrifices' (Dalisay and de Guzman 2016: 708–709).

It highlights the value of easy access to necessary resources that assist and instruct family members. This includes public markets, supermarkets and other commercial spaces where one may easily get food, medication, and other essentials; it also includes schools and hospitals or health centers for sickness and emergencies. People's decisions to remain in the area despite the risk of floods are influenced by the convenience of having these amenities close by. Taking into account the accessibility of necessary infrastructure inside the flood-prone area, this also suggests that the region's urban or land-use planning is deficient.

This analysis reveals that a range of practical, emotional, and personal factors influence people's reluctance to relocate. The factors that are most strongly associated with this behavior are things like a sense of community belonging, sentimental attachment to one's current home, lack of other options, and dependence on one's current location for employment.

Table 2. Grouped Attribute Related to Familiarity with the Current Environment despite its Challenges

| <i>Factors</i> | <i>Attributes</i> | <i>Loadings</i> |
|----------------|--|-----------------|
| | <i>Item 21. We know who to call during emergencies or floods</i> | <i>.644</i> |

| | | |
|---|--|-------------|
| <i>Familiarity with the Current Environment</i> | <i>Item 29. We can rise again after any calamity like flooding.</i> | <i>.607</i> |
| | <i>Item 7. Our place is near my workplace</i> | <i>.605</i> |
| | <i>Item 10. Moving furniture and belongings is difficult and troublesome</i> | <i>.543</i> |
| | <i>Item 22. We know how to safely evacuate our family during floods.</i> | <i>.536</i> |
| | <i>Item 30. We haven't lost hope even though our area gets flooded</i> | <i>.508</i> |

Table 2 reveals factors that are related to resilience and familiarity with the current environment despite challenges. Item 21: "We know who to call during emergencies or floods" - Having a network or knowing who to contact in an emergency greatly increases resilience and familiarity with the existing environment, as indicated by the attribute with the highest loading (0.644).

Item 29: "We can rise again after any calamity like flooding." - Resilience and familiarity with the existing environment are strongly correlated with the belief that one can overcome hardship and continue, as indicated by the item's loading of 0.607.

Item 7: "Our place is near my workplace" - Due to its ease of access in an emergency, this attribute's loading of 0.605 suggests that being close to one's place of employment is connected with resilience and familiarity with the current environment.

Item 10: "Moving furniture and belongings is difficult and troublesome" - This item has a loading of 0.543, indicating that people may be less likely to consider moving if they believe it will be difficult to move furniture and other possessions. This could lead to a greater sense of resilience and familiarity with the current surroundings.

Item 22: "We know how to safely evacuate our family during floods." - This attribute's loading of 0.536 indicates that resilience and familiarity with the current environment are related to knowing how to safely evacuate during floods and being prepared for them.

Item 30: "We haven't lost hope even though our area gets flooded" - With a loading of 0.508, this attribute suggests that resilience and familiarity with the current environment are associated with sustaining optimism and hope in the face of recurring challenges such as flooding.

These results demonstrate how crucial psychological and practical preparedness are for building familiarity and resilience in a challenging environment. People who have faith in their abilities to handle situations, remain optimistic despite hardship, and are aware of their surroundings practically are more likely to be resilient and comfortable in their current environments. The longer people live in a community they are more confident to deal with exposure to natural hazards (Bollettino, et., al., 2020, Usamah, et. al., 2014, Villano, et. al., 2020).

Table 3. Grouped Attribute Related to Adaptability in dealing with periodic challenges posed by floods

| <i>Factors</i> | <i>Attributes</i> | <i>Loadings</i> |
|---------------------|--|-----------------|
| <i>Adaptability</i> | <i>Item 2. The flood is manageable and temporary</i> | <i>.732</i> |
| | <i>Item 1. We're accustomed to floods because they occur only occasionally</i> | <i>.723</i> |

Table 3 indicates attributes related to resilience and adaptability in dealing with periodic challenges posed by floods. The analysis reveals two key attributes associated with this factor: Item 2: "The flood is manageable and temporary" - With the highest loading of 0.732, this attribute indicates that resilience and flexibility in the face of recurring challenges are greatly enhanced when floods are viewed as temporary and manageable. This way of looking at things probably helps people stay optimistic and in control during floods.

Item 1: "We're accustomed to floods because they occur only occasionally" - Resilience and adaptability are closely associated with being acclimated to floods because they happen infrequently, as indicated by this attribute's loading of 0.723. People who perceive floods as infrequent rather than continuous problems may find it easier to modify their actions and coping mechanisms when floods do come.

People who misjudged Yolanda's effects decided not to evacuate. Past experiences combined with the realization of how crucial it is to safeguard material possessions and means of subsistence meant that locals were ready to take chances during a disaster. (Eadie et. al,2020)

These results highlight how crucial attitude and perspective are to building resilience and adaptability when dealing with common issues like floods. One of the most important things that helps people efficiently handle and cope with flood-related issues is the belief that floods are temporary, controllable events, and that people should get used to them occasionally.

Table 4. Grouped Attribute Related to Responses and Strategies for coping with flood-related challenges

| Factors | Attributes | Loadings |
|--|---|-----------------|
| Responses and Strategies for Coping with Flood-Related challenges | Item 28. We worry about our belongings if we're in the evacuation center | .700 |
| | Item 25. We hope the government will find a way to address this issue | .670 |
| | Item 20. We keep an eye on the warning system in our area | .595 |

Table 4 shows the concerns of the respondents regarding the response and strategies for coping with flood-related challenges. Item 28 "We worry about our belongings if we're in the evacuation center with the highest loading of 0.700. People living in Davao City's flood prone areas were so concerned with their hard-earned belongings left at home when advised by the authorities to temporarily take shelter in the evacuation area. Secondly, Item 25 "we hope the government will find a way to address the issue" with the second highest number of loading of 0.670. They trust their government's plans and programs in addressing frequent flooding in their area. They are also attentive to the warning systems or alarms available in their area especially during heavy rains. As depicted in Item 20 "We keep an eye on the warning system in our area" having a loading of 0.595.

These attributes are very important to note especially to the urban planners for them to consider the situation of people living in flood prone areas and for the emergency response and planner to consider the efficacy and location of their warning system.

Table 5. Grouped Attribute Related to Strategies for Flood Preparedness and Response

| Factors | Attributes | Loadings |
|--|---|-----------------|
| Flood Preparedness and Response | Item 17. We have prepared emergency kits | .747 |
| | Item 15. Floods usually subside after a few hours | .733 |
| | Item 16. We know where the safe areas are if the flood really gets worse | .725 |

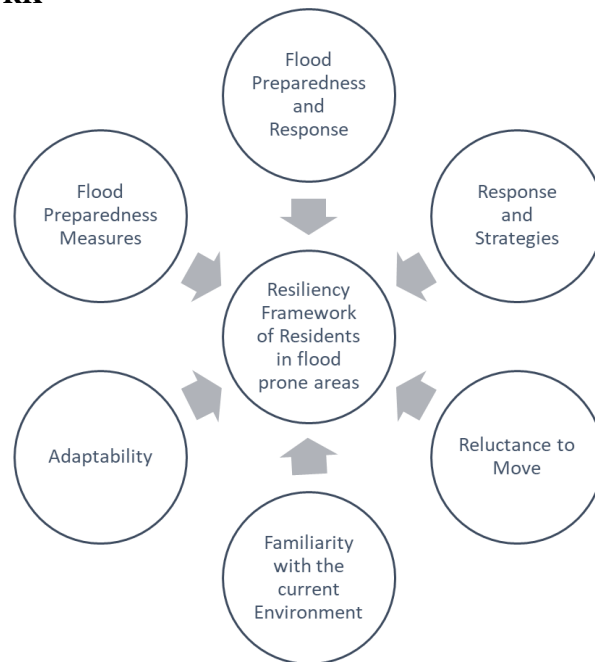
Table 5 demonstrates the preparedness and response of the people living in the flood prone areas in Davao City. With the past experience of flooding in their area they were able to prepare necessary things to do during the actual scenario. Item 16 "we know where the safe areas are if the flood really gets worse" with loadings of 0.725 - residents were aware of the evacuation area set up by the local authorities. The affected residents also prepare emergency kits as stated by Item 17 "We have prepared emergency kits" with loading 0.747 - especially to those who have medications and elderly that frequently need medical attention. Lastly, Filipinos were known for being positive people during difficult times. They never lost hope and tend to believe that current hardships were just a temporary challenge as manifested by Item 15 "floods usually subside after a few hours" with loading 0.733.

Table 6. Grouped Attribute Related to Flood Preparedness Measures

| Factors | Attributes | Loadings |
|-----------------------------|--|----------|
| Flood Preparedness Measures | Item 19. We always monitor for warnings of upcoming floods | .659 |
| | Item 5. We have an elevated storage area to keep our belongings safe from flooding | .605 |
| | Item 4. We built a second floor in preparation for flooding | .550 |

Table 6 illustrates the preparedness of residents living in Davao City’s flood prone areas. Item 19 “we always monitor for warnings of upcoming floods” with highest loading of 0.659 - with the aid of technology such as news reports from television or radio stations, social media and sms from authorities like NDRRMC (National Disaster Risk Reduction and Management Council), residents had multiple access to information. For years living in the flood prone areas, they innovate measures to protect their belongings says Item 5 “we have an elevated storage area to keep our belongings safe from flooding” with a loading of 0.605. Moreover, others do engineering controls to also protect themselves as manifested by Item 4 “we built a second floor in preparation for flooding with a loading of 0.550. People residing in the flood prone areas tend to adapt to the effects of flooding in their home. They were able to create ingenious solutions to protect themselves and their belongings. Awareness for possible disaster caused by flooding, the residents have multiple sources of information for them to prepare especially during bad weather.

RESILIENCY FRAMEWORK



The Resilience Framework of Residents, which covers communities' capacity to recover from flood damages through resilient social, economic, and infrastructure initiatives, is essential to long-term resilience (White, 2020). Moreover, Responsiveness to Science and Environment is essential in making sure that communities are ready for future climate-related difficulties by incorporating environmental factors and scientific research into local planning processes (Green et al., 2018).

The modifications that people and communities undertake to live sustainably in flood-prone areas are referred to as adaptations. This could entail changing architectural plans or implementing fresh farming methods that are more suitable for humid environments (Brown, 2022). On the other hand, even in situations where there is a considerable

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risk of flooding, residents may be reluctant to relocate due to psychological and financial reasons, as noted by Davis (2020).

Family Security in the Environment emphasizes the necessity of a stable and safe environment that promotes families' mental and physical health. This element is essential for preserving communal harmony and guaranteeing the long-term viability of safety protocols (Martin & Thompson, 2022).

Each of these components is interconnected, reinforcing the need for a comprehensive and integrated approach to manage flood risks effectively. By addressing these areas holistically, communities can enhance their preparedness, response, and overall resilience against flooding.

CONCLUSION

The results show that factors ranging from practical, emotional, and personal affect their decisions of staying at their homes and locations despite being consistently vulnerable to flood. Because of the resident's confidence in themselves, their experiences in handling the flood situation, and their optimistic attitude toward the challenge, they remain resilient regardless of the impact the disaster brought to their homes and families. Moreover, their belief that the flood effects are temporary and that they can always rebuild and restructure their homes contribute to their resiliency. The results of this study demonstrate that residents are left with no option but to remain in their locations. The residents have established their lives, families, and livelihoods despite their community being a flood prone area. It calls for a challenge to the authority and the policymakers that when putting up a residential area, it is ensured that the area is safe from destructing disasters such as flood. More so, urban planners and development workers must take into consideration the perspective of the current and future residents and their proximity to emergency and essential services upon creating plans for residential development.

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