# Why we need Bayanihan Buoyancy.

By Shella Mae Espiritu April 2025

Co-writer Editor and Reviewer: Peter De Ceuster

This mission statement and report created for esteemed President Marcos, congress and anyone interested in aiding our research, consists of Part A and Part B. Part A is our Assessment of the population, Part B is our Assessment of actual risk. (if the risk is present or not)

# Part A: Vulnerability Assessment: Identifying Disadvantaged Populations in High-Flood-Risk Barangays of Luna, Pudtol, Santa Marcela, and Flora, Apayao Province

## I. Executive Summary: beating mother nature with facts.

Science are the facts. The first part of this report provides a vulnerability assessment focused on identifying Disadvantaged populations residing within high-flood-risk barangays (villages) in the municipalities of Luna, Pudtol, Santa Marcela, and Flora, located in Apayao province, Philippines. The analysis aims to furnish actionable intelligence for a charitable organization considering targeted humanitarian interventions, such as the distribution of life jackets. The assessment synthesizes available data on flood hazards, poverty indicators, population demographics, and broader provincial vulnerabilities, primarily drawing from publicly available reports and datasets referenced herein.

The municipalities of Luna, Pudtol, Santa Marcela, and Flora are consistently identified as highly susceptible to severe flooding, particularly during typhoons and periods of intense rainfall, due to their low-lying geography near the Apayao River system. While detailed, barangay-level flood hazard mapping is confirmed for Luna through LiDAR data, equivalent granular mapping for Pudtol, Santa Marcela, and Flora was not available in the reviewed materials, representing a significant data gap.

Barangay-level poverty statistics are also not readily available. Consequently, the analysis relies on proxy indicators, including municipal income classification and data from the Pantawid Pamilyang Pilipino Program (4Ps). Pudtol (4th Income Class) and Santa Marcela (high number of 4Ps beneficiaries) emerge as municipalities likely facing higher concentrations of poverty among the four studied.

Based on the intersection of identified flood risk and poverty proxies, several barangays are tentatively prioritized for intervention. These include specific barangays within Luna identified via its detailed flood map (requiring map access for specifics), Brgy. Swan and other flood-prone areas in Pudtol, and Brgy. Nueva-Marcela and other flood-prone areas in Santa Marcela. Barangays in Flora also warrant attention due to high flood risk.

An estimation of the Disadvantaged population within these high-risk zones was conducted, relying heavily on proxy data and requiring external sourcing of barangay-level population figures. The resulting estimates are indicative and carry a significant margin of error due to data limitations, particularly the absence of granular poverty and population data at the barangay level.

Contextual factors significantly exacerbate vulnerability. Apayao province exhibits weaknesses in transportation infrastructure (low road density, frequent road closures during floods) and communications capacity (limited household access to internet, TV, radio), potentially isolating communities and hampering aid delivery during emergencies.

Key recommendations include:

1. Prioritizing intervention efforts in the identified high-risk, high-poverty-proxy barangays in Luna, Pudtol, and Santa Marcela, while acknowledging Flora's flood risk.
2. Developing robust logistical plans that anticipate access challenges.
3. Engaging local communities and Disaster Risk Reduction and Management (DRRM)

## II. Introduction

**Purpose:** The primary objective of this report is to identify and estimate the size of the Disadvantaged population residing in barangays designated as high-flood-risk zones within four specific municipalities of Apayao province: Luna, Pudtol, Santa Marcela, and Flora. This analysis seeks to provide targeted, actionable intelligence to support the strategic planning and resource allocation of a charitable organization considering interventions, such as the distribution of life-saving equipment like foam life jackets, in flood-vulnerable communities.

**Scope:** The geographical scope is strictly limited to the municipalities of Luna, Pudtol, Santa Marcela, and Flora within the province of Apayao, Philippines. The analytical focus centers on the intersection of flood hazard exposure and socioeconomic vulnerability, specifically poverty. The assessment relies predominantly on information extracted from a corpus of provided research materials, including government reports, disaster assessments, news articles, and demographic data.

**Methodology Overview:** The analytical approach involved several steps:

1. Collating and reviewing data pertaining to flood hazards in the target municipalities, seeking barangay-level specificity where possible from sources like PAGASA, LiDAR surveys, and disaster reports.
2. Gathering available poverty statistics and socioeconomic indicators, including provincial and municipal data from the Philippine Statistics Authority (PSA) and the Department of Social Welfare and Development (DSWD), particularly focusing on Listahanan or 4Ps beneficiary data as proxies where granular poverty incidence was unavailable.
3. Compiling population data, primarily from the 2020 Census, at the municipal level, noting the need for barangay-level data for precise estimation.
4. Identifying barangays exhibiting an overlap of high flood risk and indicators of high poverty concentration.
5. Estimating the number of Disadvantaged individuals residing within these identified high-risk, high-poverty barangay zones, acknowledging the assumptions and limitations imposed by data availability.
6. Contextualizing these findings by examining broader provincial vulnerability assessments, infrastructure challenges, and the roles of local disaster management bodies.

**Significance:** Understanding the specific locations where poverty and high flood risk converge is critical for effective humanitarian action. Disasters disproportionately affect the Disadvantaged, who often live in more hazardous areas and possess fewer resources to cope and recover. This targeted analysis aims to enhance the efficiency and impact of aid distribution by guiding resources towards the populations facing the most significant compound risks within the specified municipalities of Apayao.

## III. Context: Disaster Risk and Socioeconomic Landscape of Apayao Province: Knowing the land.

**Geographic and Demographic Overview:** Apayao is a landlocked province situated in the Cordillera Administrative Region (CAR) of the Philippines. According to the 2020 Census of Population and Housing, the province has a total population of 124,366 persons, residing across 133 barangays within its seven municipalities. The provincial capital is Kabugao. Apayao's geography is characterized by a distinct topographical division: the mountainous 'Upper Apayao' comprising Calanasan, Kabugao, and Conner, and the low-lying 'Lower Apayao' encompassing Luna, Pudtol, Santa Marcela, and Flora. This topography influences the types of natural hazards prevalent in different areas. Based on 2020 household population data, Conner (27,465) and Luna (21,172 / 21,297 in another source) are the most populous municipalities among those with available data in the sources.

The province exhibits a relatively young demographic structure. Data from the 2020 Census indicates that the largest age cohorts are 10-14 years old (13,012 persons) and 15-19 years old (12,476 persons). The overall sex ratio for the province in 2020 was approximately 108 males for every 100 females, suggesting a slight male predominance overall, although females tend to outnumber males in the older age groups (65 and over).

**General Hazard Profile:** Apayao province is exposed to a range of natural hazards, posing significant risks to its population and infrastructure. Key hazards include typhoons, riverine flooding, landslides, and earthquakes. The Philippines sits within a region frequently affected by tropical cyclones, and Apayao often lies in the path or experiences the peripheral effects of these systems. These typhoons typically bring intense rainfall, which acts as a primary trigger for the province's other major hazards: flooding and landslides.

Historical events underscore this vulnerability. In November 2019, continuous heavy rains, attributed to the tail-end of a cold front interacting with the northeast monsoon, caused widespread devastation. The provincial government declared a Red Alert status due to "extreme flooding" in the low-lying municipalities (Luna, Pudtol, Santa Marcela, Flora) and numerous landslide and rockfall incidents in the upper towns (Calanasan, Kabugao, Conner). This event led to evacuations, submerged farmlands, and rendered major road networks impassable. More recent weather systems, such as the hypothetical Typhoon MARCE described in situational reports (dated Nov 2024), prompted the hoisting of Tropical Cyclone Wind Signal No. 4 over parts of Apayao, including the target municipalities, indicating a threat of very strong winds and associated impacts. Similarly, forecasts during Typhoon Egay highlighted the potential for over 200 mm of rainfall in northern Apayao, explicitly warning of a high likelihood of flooding and landslides. Landslides are noted as a particular concern in Upper Apayao, while flooding is more common downstream, especially near the Apayao River which affects the target municipalities in Lower Apayao.

**Provincial Poverty and Vulnerability Context:** Assessing the socioeconomic vulnerability of Apayao requires examining poverty levels and broader coping capacities. Data on poverty incidence presents some variation depending on the source and year. A Pacific Disaster Center (PDC) profile, likely using data around 2018, reported a provincial poverty incidence of 16.0%. In contrast, a Malay Wikipedia entry, citing the Philippine Statistics Authority (PSA), indicates a significantly lower poverty rate of 4.70% for 2021. This substantial difference underscores the critical importance of utilizing the most current and official PSA statistics whenever possible for planning purposes. The discrepancy could stem from various factors, including actual socioeconomic improvements over the period, methodological changes in poverty measurement, or differences in data sources and reporting timeframes. Regardless of the precise figure, poverty exists within the province. Apayao is classified as a third-income class province, reflecting its overall economic standing.

Broader vulnerability assessments provide further context. The PDC assessment rated Apayao's overall Multi-Hazard Risk (MHR) as Low (Rank 57/84) and Resilience (R) as Medium (Rank 45/84). Its overall Vulnerability (V) was assessed as Medium (Rank 39/84), primarily driven by factors related to Environmental Stress and Information Access Vulnerability. This suggests that environmental degradation and challenges in disseminating information to the populace are key underlying weaknesses. Foresight related to floods can protect the population.

Interestingly, the province's overall Coping Capacity (CC) was rated as High (Rank 29/84) in the same assessment. However, this relatively positive aggregate score masks critical weaknesses in specific areas. Hence reason the more for our research to focus on exactly these areas. The assessment explicitly identified lower capacity related to Transportation (low road density, distance to major transport hubs) and Communications (limited household access to internet, television, radio). This apparent contradiction is significant; while the province might possess certain resources or institutional structures contributing to a 'high' overall score, the practical ability to respond to disasters, particularly in reaching remote or flood-isolated communities, could be severely hampered by these specific infrastructural deficits in transportation and communication. This directly impacts the feasibility and effectiveness of delivering aid during emergencies.

## IV. Flood Hazard Assessment in Target Municipalities (Luna, Pudtol, Santa Marcela, Flora)

**Evidence of High Flood Risk:** Multiple sources consistently corroborate that the municipalities of Luna, Pudtol, Santa Marcela, and Flora, situated in the lower, downstream areas of Apayao province, are particularly prone to significant flooding events. Their location in low-lying terrain, often adjacent to the Apayao River and its tributaries, makes them highly susceptible to inundation following periods of heavy or sustained rainfall, frequently associated with typhoons or monsoonal activity.

Specific disaster events provide concrete evidence of this high risk. The November 2019 flooding event, which placed Apayao under Red Alert, resulted in "extreme flooding" across these four municipalities. Reports from that period detail submerged farmlands, flash floods forcing resident evacuations, and critical road closures, including the Apayao-Cagayan Road near Luna and the Kabugao-Pudtol-Luna-Cagayan Boundary Road. During this event, Flora reported the highest number of affected families (210), followed by Sta. Marcela (176), Luna (106), and Pudtol (60) receiving DSWD assistance, indicating widespread impact across all four towns. Furthermore, high-level warnings (TCWS No. 4) were issued for these northern Apayao municipalities during the hypothetical Typhoon MARCE, signifying imminent danger from the storm system. Forecasts associated with Typhoon Egay also projected exceptionally heavy rainfall (over 200 mm) for northern Apayao, explicitly stating a high likelihood of flooding in susceptible areas.

**Available Flood Hazard Mapping Data:** Efforts have been made to map flood hazards in the Philippines, utilizing technologies like LiDAR (Light Detection and Ranging). For the municipality of Luna, Apayao, a specific 5-year return period flood hazard map with a 10-meter resolution exists, generated through the Phil-LiDAR 1 Program. This map delineates potential inundation extents based on rainfall exceeding a 5-year probability threshold (20% chance in any given year) and visually identifies high-hazard areas in red. According to the source information, this map data is publicly viewable and downloadable.

The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) is another key source for flood hazard information, providing maps at various scales (1:10,000, 1:15,000, 1:50,000). However, the available documentation does not confirm the existence or specific details of PAGASA flood maps covering the barangays within Pudtol, Santa Marcela, and Flora. Similarly, the GeoRiskPH platform's HazardHunterPH tool offers hazard assessments , but specifics regarding barangay-level flood map availability for these three municipalities are not detailed in the provided materials. The existence of detailed LiDAR surveys and flood mapping projects for other river basins, like the Pamplona River , suggests that similar detailed data *might* exist for the Apayao river system impacting the target towns, but its availability for Pudtol, Santa Marcela, and Flora is not confirmed within the reviewed documents.

This discrepancy in available mapping data is critical. While a detailed, quantitative basis for identifying high-risk barangays exists for Luna , the assessment for Pudtol, Santa Marcela, and Flora must currently rely more heavily on qualitative reports of historical flooding and general vulnerability assessments , lacking the same level of spatial precision. This represents a key data gap for comprehensive barangay-level risk identification across all four target municipalities.

**Identification of High-Risk Areas/Barangays (Synthesis):** Based on the available information, the identification of high-flood-risk barangays proceeds as follows:

* **Luna:** Specific barangays falling within the designated high hazard (red) zones on the 5-year return period LiDAR flood map should be considered high-risk. Accessing the actual map data is required to list these specific barangays.
* **Pudtol, Santa Marcela, Flora:** Given the absence of confirmed detailed barangay-level maps in the reviewed sources, identification relies on inference and qualitative data.
	+ These municipalities are confirmed as high-risk zones based on repeated historical flooding events.
	+ Barangays located in close proximity to the Apayao River or its major tributaries are likely at higher risk.
	+ Local knowledge from Municipal Disaster Risk Reduction and Management Offices (MDRRMOs) would be invaluable; a photo caption referenced the Pudtol MDRRMO in the context of road closures during floods, suggesting they possess localized hazard information.
	+ A vulnerability assessment focused on cassava farming identified specific barangays impacted by typhoon rains: Nueva-Marcela (in Sta. Marcela), Swan (in Pudtol), and Sta. Lina (in Luna). While this study focused on agricultural impacts (crop damage, root rot), the exposure of these areas to heavy rains and typhoons makes them strong candidates for general flood risk as well. However, caution is warranted in directly equating agricultural flooding with residential inundation risk without further corroboration.

**Table 1: Flood Hazard Assessment Summary for Target Municipalities**

| Municipality | Barangay | Data Source(s) | Assessed Flood Risk Level | Notes |
| --- | --- | --- | --- | --- |
| Luna | *Specific list* |  | High | Within High Hazard (RED) zone on 5-yr LiDAR map. Requires map access for specific barangay names. |
| Luna | Sta. Lina |  | High (Inferred) | Mentioned in vulnerability study re: typhoon/rain impacts (agricultural focus). Needs corroboration. |
| Pudtol | Swan |  | High (Inferred) | Mentioned in vulnerability study re: typhoon/rain impacts (agricultural focus). Needs corroboration. |
| Pudtol | *Other barangays* |  | High (Inferred) | Municipality confirmed high risk; specific barangays likely near rivers or known locally (MDRRMO data). |
| Santa Marcela | Nueva-Marcela |  | High (Inferred) | Mentioned in vulnerability study re: typhoon/rain impacts (agricultural focus). Needs corroboration. |
| Santa Marcela | *Other barangays* |  | High (Inferred) | Municipality confirmed high risk; specific barangays likely near rivers or known locally (MDRRMO data). |
| Flora | *Specific list* |  | High (Inferred) | Municipality confirmed high risk; specific barangays likely near rivers or known locally (MDRRMO data). |
| *All Four* | *General* |  | High | Municipalities repeatedly cited for extreme flooding events. |
| *Pudtol, Sta. Marcela, Flora* | *General* | - | Data Gap | Lack of confirmed, detailed barangay-level flood hazard maps in reviewed sources. |

*Note: "High (Inferred)" indicates risk assigned based on qualitative reports or secondary indicators, lacking direct map confirmation from the provided sources for that specific barangay.*

## V. Poverty and Socioeconomic Vulnerability in Target Municipalities: Action not words

**Analysis of Poverty Indicators:** A precise understanding of poverty distribution at the barangay level is crucial for targeted interventions. However, official barangay-level poverty incidence statistics, typically released by the PSA, were not found within the reviewed documentation for the municipalities of Luna, Pudtol, Santa Marcela, and Flora. While provincial-level poverty figures exist (), applying these directly to individual barangays or even municipalities can be misleading due to significant local variations.

In the absence of granular official poverty data, proxy indicators must be utilized. One strong proxy is data from the DSWD's Pantawid Pamilyang Pilipino Program (4Ps). This national conditional cash transfer program targets Disadvantaged and near-Disadvantaged households identified through the Listahanan national household targeting system. Therefore, the number of active 4Ps beneficiary households within a municipality can serve as an indicator of the concentration of poverty.

Reviewing available 4Ps implementation reports reveals the following counts for **Santa Marcela**:

* Q1 2020: 793 households
* September 2021: 698 households
* December 2021: 695 households
* December 2023: 647 households

While these figures show a slight decrease over time for Santa Marcela, they consistently represent a substantial number of beneficiary households. Unfortunately, the provided excerpts from the DSWD reports () do not clearly and consistently break down the 4Ps household counts for Luna, Pudtol, and Flora individually. Although provincial totals for Apayao are given (e.g., 7,324 households in Dec 2023 ), the structure of the tables in the excerpts makes it unreliable to assign the intervening numbers definitively to the other target municipalities based solely on the provided text. This represents a significant limitation in using the 4Ps data as presented for comparative poverty analysis across all four municipalities. Accessing the full DSWD reports or Listahanan data is necessary to obtain reliable municipal and barangay-level breakdowns.

**Municipal-Level Socioeconomic Profiles:** Other municipal-level data offer additional context:

* **Population (2020 Census):** Available figures from PSA data indicate the following populations for the target municipalities :
	+ Luna: 21,297 (or 21,172 in )
	+ Pudtol: 15,491
	+ Flora: 17,944
	+ Santa Marcela: Population not explicitly listed in key sources. Based on the total provincial population (124,366 ) and the sum of listed populations for the other six municipalities in (111,049), Santa Marcela's estimated 2020 population is approximately 13,317. This figure should be verified with official sources.
* **Income Class (Municipal):** Municipal income classification reflects the LGU's average annual income and financial capability. Lower classifications (higher numbers) often correlate with higher poverty levels and reduced local resources for development and disaster response. The classifications for the target municipalities are :
	+ Luna: 2nd Class
	+ Pudtol: 4th Class
	+ Flora: 3rd Class
	+ Santa Marcela: Not listed in the source. Requires external verification.

The designation of Pudtol as a 4th Class municipality is particularly noteworthy. This suggests potentially higher underlying poverty levels and greater socioeconomic vulnerability compared to 2nd Class Luna and 3rd Class Flora. This lower municipal capacity, combined with its confirmed high flood risk , elevates Pudtol as a municipality likely facing significant compounded challenges and potentially housing a higher concentration of vulnerable populations requiring assistance.

**Identification of High-Poverty Areas/Barangays:** Identifying specific *barangays* with high poverty levels remains challenging due to the data limitations outlined above (lack of barangay-level statistics, incomplete municipal 4Ps data in sources). Therefore, the approach must rely on municipal-level proxies:

1. Prioritize barangays within municipalities having lower income classifications, suggesting higher systemic poverty (i.e., Pudtol - 4th Class).
2. Prioritize barangays within municipalities showing a high absolute number of 4Ps beneficiaries, indicating a concentration of targeted Disadvantaged households (i.e., Santa Marcela - 647 households in Dec 2023 ).
3. Consider barangays within Luna (2nd Class) and Flora (3rd Class) based on flood risk, but potentially with slightly lower poverty-related priority compared to Pudtol and Santa Marcela, based *only* on the available proxy indicators.

**Table 2: Socioeconomic Indicators for Target Municipalities**

| Municipality | Population (2020 Census) | Income Class | 4Ps Households (Dec 2023) | Provincial Poverty Rate Context | Notes |
| --- | --- | --- | --- | --- | --- |
| Luna | 21,297 | 2nd | Data Gap in sources | 16.0% (c. 2018) | Population figure slightly differs in (21,172). 4Ps count not reliably extractable from sources. |
|  |  |  |  | 4.70% (2021) |  |
| Pudtol | 15,491 | 4th | Data Gap in sources | 16.0% (c. 2018) | Lowest income class among the four, suggesting higher potential poverty. 4Ps count not reliably extractable. |
|  |  |  |  | 4.70% (2021) |  |
| Santa Marcela | ~13,317 (Estimated) | Data Gap | 647 | 16.0% (c. 2018) | Population estimated by subtraction, needs verification. Income class missing from. High 4Ps count. |
|  |  |  |  | 4.70% (2021) |  |
| Flora | 17,944 | 3rd | Data Gap in sources | 16.0% (c. 2018) | 4Ps count not reliably extractable from sources. |
|  |  |  |  | 4.70% (2021) |  |
| *Apayao Prov.* | 124,366 | 3rd | 7,324 | 16.0% (c. 2018) | Note discrepancy between 2018 PDC and 2021 PSA-cited poverty rates. |
|  |  |  |  | 4.70% (2021) |  |

*Note: Population for Sta. Marcela is estimated. Income class for Sta. Marcela and 4Ps counts for Luna, Pudtol, Flora require external verification due to gaps in the provided sources.*

## VI. Estimation of Disadvantaged Population in High-Risk Zones: Who needs assistance?

**Data Sources:** Estimating the number of Disadvantaged individuals residing within the identified high-risk barangays requires integrating three key datasets:

1. **List of Prioritized Barangays:** As identified in Table 3.
2. **Barangay-Level Population Data:** Ideally, the official 2020 Census of Population and Housing data at the barangay level. *Crucially, this data was not available in the reviewed sources and could be obtained externally from the PSA.* Municipal populations are insufficient for this granular estimation.
3. **Poverty Data:** The most accurate data would be official barangay-level poverty incidence rates from PSA. As these are unavailable in the sources, proxies must be used, with significant caveats:
	* **Municipal Poverty Incidence:** If official municipal-level poverty incidence rates can be sourced externally, they can be applied to barangays within that municipality.
	* **Provincial Poverty Incidence:** Using the provincial rate (e.g., the 4.70% from 2021 cited in , or the 16.0% circa 2018 from ) as a proxy for all barangays is a less precise option, masking significant local variation. The choice of rate and its year must be clearly stated.
	* **4Ps Proxy Ratio:** Calculating a ratio based on the number of 4Ps households per municipality relative to the total number of households in that municipality (requires external data on total households). This assumes the 4Ps beneficiary ratio accurately reflects the overall poverty rate within the municipality's barangays.

## VIII. Contextual Factors: Vulnerability and Coping Capacity: What can be done.

Understanding the number of people at risk requires considering the broader context of vulnerability and the capacity of communities and institutions to cope with hazards. Provincial assessments and event reports highlight several critical factors for Apayao:

**Insights from Provincial Vulnerability Assessments:** The Pacific Disaster Center's assessment identified Environmental Stress and Information Access Vulnerability as key drivers of overall vulnerability in Apayao. Environmental Stress may relate to factors like deforestation or land degradation (potentially linked to agriculture or resource extraction), which can exacerbate flood and landslide risks. Information Access Vulnerability points to difficulties in reaching the population, particularly those in remote areas, with timely warnings, public health information, or details about available assistance. This is compounded by limited household access to amenities like internet, television, and radio, necessitating alternative communication strategies such as siren-based notifications.

While Apayao scored relatively high on overall Coping Capacity, specific weaknesses in Transportation Capacity and Communications Capacity were flagged. The province suffers from low road density (0.31 km per sq km) and a high average distance to ports and airports (39.2 km). This infrastructural deficit directly impacts mobility, evacuation capabilities, and the logistics of delivering relief supplies. Similarly, weaknesses in communication infrastructure hinder the dissemination of warnings and coordination of response efforts. Recommendations from the assessment align with these findings, emphasizing the need for enhanced forestry protection, sustainable agriculture, improved communication infrastructure (including low-tech options), and addressing the low road density.

**Infrastructure and Access Challenges:** The practical implications of these vulnerabilities are starkly illustrated during actual disaster events. Reports from the November 2019 floods explicitly documented the impassability of major road networks due to floodwaters and landslides. This included crucial routes connecting Apayao to neighboring provinces (Apayao-Cagayan Road, Apayao-Ilocos Norte Road) as well as internal arteries like the Kabugao-Pudtol-Luna-Cagayan Boundary Road. Heavy equipment and personnel were required for extensive clearing operations simply to allow the delivery of relief goods to affected areas. This historical evidence powerfully confirms the transportation vulnerability identified in assessments. The combination of known low road density and documented instances of road closures during floods strongly suggests that physical access for aid distribution (like life jackets) during or immediately after a major flood event will ***be a primary logistical hurdle in the target municipalities***. Planning must therefore incorporate strategies to overcome the potential isolation of barangays. Additionally, relatively low household electrification rates (ranked 69/84 provincially) could further impede communication and coping mechanisms during extended power outages following disasters.

**Role of Local DRRM Offices:** Despite these challenges, local disaster risk reduction and management structures are active. The Apayao Provincial Disaster Risk Reduction and Management Office (PDRRMO) and the Municipal DRRM Offices (MDRRMOs) in towns like Pudtol play crucial roles in coordinating responses, working with national agencies like DSWD, assessing damages, and providing information for declarations of a state of calamity. These local offices are vital repositories of localized knowledge and are the primary entities recommended for obtaining more detailed hazard maps, vulnerability assessments, and information on evacuation plans, complementing national frameworks like the National DRRM Plan (NDRRMP) which emphasizes LGU roles. Initiatives like developing Disaster Risk and Vulnerability Assessments (DRVAs) or Community-Based Flood Risk Management Strategies (CBFRMS) often involve these local bodies.

## IX. Conclusion and Recommendations

**Summary of Key Findings:** This dynamic assessment confirms that the municipalities of Luna, Pudtol, Santa Marcela, and Flora in Apayao province face significant and recurring flood risks, substantiated by historical event data and available hazard information. While detailed flood mapping provides granular risk identification for Luna , limited data for Pudtol, Santa Marcela, and Flora is available in the reviewed sources, necessitating reliance on qualitative assessments and inferences for these areas, nonetheless, we have gathered sufficient evidence to establish a strong foundation for our charity campaign.

Identifying barangays where high flood risk intersects with high poverty levels is somewhat hampered by the lack of readily available, official barangay-level poverty statistics but estimates clearly show there is reason for concern. Using municipal income class and DSWD 4Ps beneficiary data as proxies, this analysis tentatively prioritizes flood-prone barangays within Pudtol (lowest income class) and Santa Marcela (high 4Ps count), alongside high-hazard barangays identified in Luna's flood map, as areas likely concentrating the most vulnerable populations (Table 3). Flood-prone barangays in Flora also warrant attention.

Estimates of the Disadvantaged population within these high-risk zones (Table 4) are heavily contingent on acquiring external barangay-level population data and rely on poverty proxies. Consequently, our estimates are indicative at best and should be treated with caution, primarily serving to illustrate potential scale (to help pinpoint our cause rather than very exact, precise figures.

Critically, contextual factors significantly shape vulnerability. Deficiencies in transportation infrastructure, leading to frequent road closures during floods , combined with limited communication access for many households , pose major logistical barriers to warning dissemination, evacuation, and aid delivery in these municipalities. These factors must be central to any intervention planning.

**Recommendations for Targeted Intervention:**

1. **Prioritize High-Risk/High-Vulnerability Barangays:** Focus initial intervention efforts, such as life jacket distribution, on the highest-priority barangays identified in Table 3. This includes mapped high-risk barangays in Luna, and inferred high-risk barangays in Pudtol and Santa Marcela, given their heightened vulnerability suggested by poverty proxies. Flood-prone areas in Flora should also be considered.
2. **Develop Resilient Logistics:** Create logistical plans that explicitly account for potential road impassability and communication breakdowns during flood events. Consider strategies like pre-positioning essential supplies in accessible locations within or near target municipalities before peak flood seasons, or exploring alternative transport methods (e.g., boats, if feasible and safe) based on local geography and conditions.
3. **Engage Local Stakeholders:** Collaborate closely with barangay leaders, community organizations, and the respective MDRRMOs in Luna, Pudtol, Santa Marcela, and Flora. Local engagement is crucial for ensuring interventions are culturally appropriate, effectively targeted, and build upon existing community capacities and preparedness efforts.

**Scaling and logistics:**

1. **Total Population of Target Municipalities:** The combined population of the four municipalities based on the 2020 Census data :
	* Luna: 21,297
	* Pudtol: 15,491
	* Santa Marcela: 13,317 (Estimated based on provincial total minus other listed municipalities )
	* Flora: 17,944
	* **Total Population (Four Municipalities): 68,049**
2. **Estimate Population Exposed to Flood Risk:** While detailed barangay-level flood maps aren't available for all four towns in the reviewed materials, we know these specific municipalities are the most flood-prone in Apayao.A provincial assessment estimated that 36% of Apayao's population is exposed to flood hazards.Since Luna, Pudtol, Santa Marcela, and Flora are known low-lying, high-risk areas, this provincial average is likely a *conservative* estimate for these specific towns. Using this 36% figure as a baseline:
	* Estimated Exposed Population = 68,049 \* 36% = **24,498 individuals**
3. **Estimate Disadvantaged Population within the Exposed Group:** Identifying the Disadvantaged population within these flood zones is challenging without granular data. We can use the provincial poverty incidence as a proxy. The available data shows a rate of 16.0% (circa 2018) and a more recent rate of 4.70% (2021).Given that the goal is charitable aid targeting vulnerability, and considering factors like Pudtol's 4th class income status and Santa Marcela's significant number of 4Ps families , using the higher, albeit older, 16.0% figure might provide a more cautious estimate for planning purposes, acknowledging the discrepancy with the latest official statistic.
	* Estimated Disadvantaged Population in High-Risk Zones = 24,498 \* 16.0% = **3,920 individuals**

**Estimated Number for Distribution:**

Based on this calculation, an estimated **approximately 3,900 to 4,000 individuals** represent the Disadvantaged population living within the high-flood-risk areas of Luna, Pudtol, Santa Marcela, and Flora. This figure could serve as a target number for life jacket distribution.

**Important Considerations and Caveats:**

* **Flood Exposure Underestimation:** The 36% flood exposure rate is a provincial average.The actual percentage of the population living in high-risk zones within these four specific low-lying municipalities is likely higher.
* **Poverty Rate Uncertainty:** The 16.0% poverty rate used is from around 2018.While potentially more reflective of underlying vulnerability for aid planning than the much lower 2021 figure of 4.70% , it is older data. The actual current poverty rate within the flood zones could differ.
* **Distribution Assumptions:** This estimate assumes poverty is evenly distributed among the flood-exposed population. In reality, poorer households may be disproportionately located in the most hazardous areas.
* **Individual vs. Household:** This estimate is for individuals. If distribution is planned per household, average household size data would be needed to adjust the figure.

# Part B: Risk Assessment: The birth of an NGO

# Flooding Events and Fatalities in the Philippines: An Analysis of Trends (1985-2024)

## 1. Executive Summary: Is there a need for charity?

The Republic of the Philippines faces significant and recurring threats from natural hazards, particularly flooding, owing to its geographical location and climatic conditions. This report analyzes trends in significant flood events and associated fatalities in the Philippines over the past four decades (approximately 1985-2024), based on available data primarily from the EM-DAT International Disaster Database and supplemented by national sources and research literature. The analysis reveals substantial year-to-year variability in both the number of reported events meeting international criteria and the resulting human cost. Several catastrophic events, mainly linked to powerful typhoons causing storm surges, intense rainfall, and subsequent landslides, have resulted in extremely high death tolls, significantly impacting the overall statistics for specific years. While global reporting of disasters has increased, discerning precise long-term trends in flood frequency and lethality in the Philippines is complicated by evolving data collection practices, potential underreporting, and challenges in consistently disaggregating flood types (e.g., tsunami-induced vs. storm-related) and attributing fatalities solely to flooding across the entire period.1 ***The findings underscore the profound impact of floods and related hazards on the nation***, extending beyond fatalities to encompass widespread ***displacement***, significant economic losses, and considerable damage to infrastructure and agriculture.4 Addressing this persistent challenge requires a multi-faceted approach, the need for synergy, including strengthening data management systems for better risk understanding, while investing in comprehensive risk reduction measures (both structural and non-structural), and of course enhancing early warning and community preparedness, and tackling underlying socio-economic vulnerabilities, all integrated within national development planning.8

## 2. Introduction: Philippines' Vulnerability to Flooding

### Geographic and Climatic Context: Are the isles at risk?

The Philippines, an archipelago of over 7,100 islands, possesses inherent geographical characteristics that render it exceptionally vulnerable to natural hazards.11 Its location within the Pacific Ring of Fire exposes it to significant seismic and volcanic activity, including earthquakes and eruptions that can trigger secondary hazards like tsunamis and lahars.11 Furthermore, the country lies within the Western Pacific typhoon belt, the world's most active tropical cyclone basin.4 Consequently, the Philippines experiences an average of 20 tropical cyclones entering its designated Philippine Area of Responsibility (PAR) each year, with approximately five to eight making landfall, often bringing destructive winds, torrential rainfall, and storm surges.4

### Hazard Profile

Hydro-meteorological events, primarily typhoons and the floods they generate, dominate the country's disaster profile, accounting for over 80% of natural disaster occurrences in the last half-century.5 The nation experiences various types of flooding:

* **Riverine Floods:** Caused by overflowing rivers due to sustained rainfall, often associated with monsoons (like the Southwest Monsoon or 'Habagat' 15) or prolonged precipitation from tropical cyclones.
* **Flash Floods:** Rapid-onset floods, often occurring in hilly and mountainous regions with steep slopes and short catchment concentration times, triggered by intense, localized rainfall.13
* **Coastal Flooding/Storm Surges:** Inundation of coastal areas by seawater, primarily driven by the strong winds and low pressure associated with approaching typhoons.11 Historical events demonstrate the devastating potential of storm surges.13 Rising sea levels, occurring at a rate potentially higher than the global average in the Philippine region, may exacerbate this risk.13
* **Tsunami-Induced Flooding:** Coastal inundation caused by large waves generated by undersea earthquakes or, less commonly, volcanic eruptions or landslides.11 The 1976 Moro Gulf Tsunami serves as a stark reminder of this threat.12
* **Other Causes:** Flooding can also result from factors like dam overflows, intense rainfall associated with the Intertropical Convergence Zone (ITCZ) 18, or weather systems like shear lines.19

### High Exposure and Vulnerability

Compounding the high hazard frequency is significant exposure and vulnerability. Estimates suggest that at least 60% of the country's land area and 74% of its population are exposed to multiple natural hazards.4 This exposure translates into high rankings in global disaster risk assessments; the World Risk Report, for instance, has consistently placed the Philippines among the top countries globally in terms of disaster risk.3 Vulnerability is driven by factors including poverty, population density in hazard-prone areas (including coastal zones and riverbanks), reliance on climate-sensitive agriculture, and challenges in infrastructure and service provision.11

### Report Objective and Scope

Our report aims to provide an analysis of historical trends in significant flooding events and associated fatalities in the Philippines, covering the period from 1985 to 2024. The objective is to present annual data, where available, distinguishing between tsunami-related flooding and other forms of flooding ("regular floods"), and to quantify the resulting fatalities based on accessible records. This analysis seeks to inform understanding of the scale and evolution of flood risk in the country.

### Data Sources and Limitations

The primary source for compiling long-term, internationally comparable disaster data is the EM-DAT International Disaster Database, maintained by the Centre for Research on the Epidemiology of Disasters (CRED) at UCLouvain.1 EM-DAT records disasters meeting specific criteria, such as causing at least 10 fatalities, affecting 100 or more people, leading to a state of emergency declaration, or prompting a call for international assistance.1 EM-DAT provides classifications for 'Flood' and 'Tsunami' events 1 over the 40-year timeframe:

* **Disaggregation:** Consistently separating fatalities specifically caused by *tsunami-induced flooding* from those caused by *other types of flooding* (riverine, flash, storm surge) is challenging using aggregated global databases. Often, fatalities are linked to the primary triggering event (e.g., earthquake for tsunami, typhoon/storm for storm surge/rainfall flooding).11 Many significant flood events in the Philippines are secondary impacts of typhoons, which EM-DAT might classify primarily as 'Storms'.1
* **Data Completeness and Consistency:** EM-DAT's systematic collection began around 1988.1 Reporting standards, data collection capabilities within the Philippines (e.g., through agencies like the National Disaster Risk Reduction and Management Council - NDRRMC, and the Philippine Statistics Authority - PSA 15), and international reporting mechanisms may have evolved over 40 years, potentially affecting data comparability across decades.22 Underreporting, particularly for smaller events or in less accessible areas, is a recognized issue in disaster databases.29
* **Attribution:** Attributing fatalities solely to flooding during complex events involving multiple hazards (e.g., high winds, landslides, electrocution during a typhoon) is inherently difficult and may vary between reporting sources.31

Therefore, while our analytical method utilizes EM-DAT as the primary basis for the long-term trend table, we acknowledge these limitations. Supplementary information from NDRRMC situation reports 19, PSA compendiums 18, news archives 34, and academic research 31 is used to provide context and highlight specific significant events.

## 3. Historical Trends: Flood Events and Fatalities (1985-2024)

Analyzing the frequency and impact of flooding events over the past four decades reveals a pattern of significant variability, punctuated by catastrophic occurrences.

### Primary Data Table

The following table structure outlines the annual data based on our research Compiling a more complete table can be achieved in the future by taking data from the EM-DAT public database 1 and cross-referencing with annual reports from NDRRMC and PSA, which requires accessing individual reports.35

The table below , highlighting the intended structure and noting key high-impact years identified from the research material: It uses EM-DAT principles

**Table 1: Significant Flood Events and Associated Fatalities in the Philippines (1985-2024) - Based on EM-DAT Principles**

|  |  |  |  |
| --- | --- | --- | --- |
| **Year** | **Total Significant Flood Events (EM-DAT Criteria)\*** | **Total Fatalities from Floods (EM-DAT Criteria)\*** | **Notes on Major Events/Periods (from Snippets)** |
| 1985 | *-* | *-* |  |
| ... | *-* | *-* |  |
| 1990 | *-* | *-* | Luzon Earthquake (potential secondary effects) 12; Typhoon Mike (Ruping) 26 |
| 1991 | *-* | **Very High** | Typhoon Thelma (Uring) - >5,900 deaths 26; Mt. Pinatubo lahars 26 |
| ... | *-* | *-* |  |
| 2004 | *-* | **High** | Typhoon Winnie - >1,500 deaths 26 |
| *-* | *-* | *-* |  |
| 2006 | *-* | **High** | Typhoon Durian (Reming) - >1,300 deaths 26 |
| ... | *-* | *-* |  |
| 2008 | *-* | **High** | Typhoon Fengshen (Frank) - >1,500 deaths 26 |
| 2009 | *-* | **Moderate/High** | Typhoon Ketsana (Ondoy) - Severe Metro Manila flooding 24 |
| ... | *-* | *-* | 2011 noted as having high number of disaster events (36) 7 |
| 2012 | *-* | **Very High** | Typhoon Bopha (Pablo) - >1,900 deaths 26 |
| 2013 | *-* | **Extremely High** | Typhoon Haiyan (Yolanda) - >6,200 deaths 4 |
| ... | *-* | *-* |  |
| 2020 | *-* | *-* | Typhoon Ulysses (Vamco) - Significant flooding 24 |
| ... | *-* | *-* |  |
| 2023 |  PSA: 208 total natural events, 100 deaths from major | PSA: 157 total deaths from natural events | PSA data available 18 |
| 2024 | *-* | *-* | Floods/landslides reported (e.g., Mindanao, TS Yagi/Enteng) 20 |

**Footnote:** *Data-expansion is possible from EM-DAT (public.emdat.be) or compilation from annual national reports (e.g., NDRRMC, PSA). 'Flood Events' typically include occurrences meeting EM-DAT criteria (e.g., >=10 deaths or >=100 affected) classified under 'Flood' (potentially including riverine, flash, coastal/storm surge) and possibly 'Tsunami' where flooding was the major impact. Consistent disaggregation between tsunami-induced and other flood types, and precise attribution of fatalities solely to flooding across the entire period, is challenging based on available aggregated data. Data for recent years may be preliminary. 1*

### Analysis of Trends: (recent disasters)

Based on the available information and acknowledging the data limitations:

* **Variability:** The impact of flooding, particularly in terms of fatalities, appears highly variable from year to year. Years with major typhoon-induced disasters (like 1991, 2004, 2006, 2008, 2012, 2013) show dramatic spikes in death tolls compared to other years.26 This suggests that overall fatality trends are heavily influenced by infrequent but extremely high-impact events.
* **Reported Event Frequency:** Global databases like EM-DAT show a general increase in the number of *reported* natural disasters over the past decades.2 While some sources attribute this partly to improved reporting and recording 3, there is also a noted rise in climate-related events like floods and storms globally.2 Philippine data reflects high numbers of hydro-meteorological events annually.5 For example, 2011 was noted as a year with a particularly high number of recorded disaster events in the Philippines (36).7 However, determining if there's a statistically significant *increase* in the actual *occurrence* of major floods versus an increase in *reporting* requires more detailed analysis beyond the scope of these snippets.
* **Fatality Trends and Lethality:** Globally, some analyses suggest a decrease in the average number of fatalities per flood event (lethality) over recent decades.41 However, the Philippine experience, marked by recurring catastrophic events causing thousands of deaths well into the 21st century (e.g., Winnie 2004, Durian 2006, Fengshen 2008, Bopha 2012, Haiyan 2013) 26, indicates that extreme vulnerability persists, particularly concerning major typhoons and their associated flooding and landslides. While improvements in early warning and preparedness might be reducing fatalities in smaller, more frequent events, the impact of the most severe occurrences remains devastatingly high. This suggests that efforts to reduce vulnerability may not have kept pace with the intensity of the most extreme hazards or the increasing exposure of the population.

### Highlighting Significant Events

Beyond aggregated annual figures, specific events underscore the devastating potential of floods and tsunamis in the Philippines within the 1985-2024 timeframe:

* **Typhoon Ike (Nitang, 1984):** Although slightly predating the 1985 start, its impact (nearly 1,500 deaths) provides immediate context for the period's beginning.26
* **1990 Luzon Earthquake:** While primarily an earthquake disaster, major seismic events in the Philippines carry the risk of generating tsunamis or causing secondary effects like dam failures or landslides leading to flooding.12
* **Mount Pinatubo Eruption (1991 onwards):** The eruption itself and subsequent years saw devastating lahars (volcanic mudflows) triggered by rainfall, inundating vast areas and behaving like floods, causing significant destruction and displacement.26
* **Typhoon Thelma (Uring, 1991):** One of the deadliest events in Philippine history, causing catastrophic flash floods and landslides, particularly in Ormoc City, Leyte, with fatalities exceeding 5,900.26
* **Typhoon Winnie (2004):** Resulted in over 1,500 deaths, largely due to flash floods and landslides in Quezon and Aurora provinces.26
* **Typhoon Durian (Reming, 2006):** Caused widespread destruction, with nearly 1,400 fatalities, many resulting from massive mudflows (lahar-like flows) off the slopes of Mayon Volcano triggered by heavy rain.26
* **Typhoon Fengshen (Frank, 2008):** Led to over 1,500 deaths, including those from the sinking of the MV Princess of the Stars ferry, but also caused extensive flooding across several regions.26
* **Typhoon Ketsana (Ondoy, 2009):** Infamous for causing unprecedented flooding in Metro Manila and surrounding areas, highlighting urban vulnerability. While the death toll was lower than some other typhoons (around 700-1000 depending on source/scope), it affected millions and caused significant economic damage.24
* **Typhoon Bopha (Pablo, 2012):** A powerful typhoon that struck Mindanao, an area less accustomed to strong cyclones, causing over 1,900 deaths and massive damage, largely from flash floods and landslides.26 It was also one of the costliest typhoons recorded.26
* **Typhoon Haiyan (Yolanda, 2013):** One of the strongest typhoons ever recorded globally at landfall. Its devastating storm surge, particularly in Tacloban City, caused the majority of the more than 6,200 fatalities. It affected millions, destroyed over a million homes, and caused immense economic damage.4
* **Recent Events (2024):** Reports from 2024 indicate continued impacts, including floods and landslides in Mindanao due to shear lines and monsoon effects, affecting hundreds of thousands and causing fatalities 20, and flooding associated with Tropical Storm Yagi (Enteng).34 Flash floods in Maguindanao del Norte also resulted in casualties and displacement.20

These events illustrate that while annual totals fluctuate, the potential for catastrophic flooding associated primarily with typhoons, but also linked to earthquakes, volcanoes, and intense monsoon rains, remains a constant and severe threat across the Philippines.

## 4. In-Depth Discussion: Factors, Impacts, and Data Challenges: why we need Bayanihan Buoyancy, in the long term, and not the short term.

Understanding the trends in flood events and fatalities requires examining the complex interplay of hazard drivers, societal vulnerabilities, broader impacts, and the inherent challenges in data collection and interpretation.

### Drivers of Flood Risk and Fatalities

* **Natural Hazards:** The primary drivers are hydro-meteorological. Typhoons are the most significant trigger, bringing intense rainfall, strong winds that contribute to storm surges, and subsequent riverine and flash flooding.11 Seasonal monsoons (Habagat, Amihan), the Intertropical Convergence Zone (ITCZ), and weather systems like shear lines also contribute significantly to heavy rainfall and flooding.15 Climatic patterns like El Niño can lead to droughts, while La Niña periods are often associated with increased rainfall and flood risk.13 Geological hazards also play a role; earthquakes can trigger tsunamis 12, and volcanic eruptions can lead to destructive lahars when ash deposits are mobilized by rain.13
* **Climate Change:** There is growing evidence and concern that climate change is exacerbating these risks. While attributing single events to climate change is complex, observed trends and projections suggest potential increases in the intensity of the strongest typhoons, rising sea levels that worsen coastal flooding and storm surge impacts, and potentially more frequent or intense extreme rainfall events.4 Globally, a significant rise in reported climate-related disasters has been observed in recent decades.2 The Philippines, being highly exposed, is likely experiencing these amplified threats.4
* **Vulnerability Factors:** High hazard exposure is compounded by significant socio-economic vulnerability. Poverty forces many Filipinos to live in high-risk areas, such as riverbanks, steep slopes, or low-lying coastal zones, often in informal settlements with substandard housing.24 Continued population growth increases the number of people exposed.11 Rapid and sometimes unplanned urbanization concentrates populations and assets in potentially hazardous locations and can alter drainage patterns, increasing flood risk.13 Dependence on climate-sensitive livelihoods, particularly agriculture and fishing, means that floods can devastate household incomes and food security.7 Certain demographic groups may face heightened risk; studies have indicated, for example, that older adults (specifically those over 70) can be more vulnerable during flood events.31
* **Environmental Degradation:** Human activities contribute to increased flood risk. Deforestation and degradation of watersheds reduce the land's capacity to absorb rainfall, leading to faster runoff and more severe flooding downstream.12 Inadequate urban drainage systems and clogging of waterways with waste can also exacerbate localized flooding.13

### Broader Impacts Beyond Fatalities

While fatalities represent the most tragic outcome, the impacts of flooding in the Philippines are far broader:

* **Affected Population and Displacement:** Major flood events routinely affect hundreds of thousands, sometimes millions, of people.5 Displacement is a significant consequence, with large numbers forced into evacuation centers or to stay with host families, sometimes for extended periods.6 Between 2010 and 2021, Asia and the Pacific accounted for over 225 million disaster displacements, with floods and storms being major drivers.6
* **Economic Losses:** Floods inflict substantial economic damage. Annual direct damages from all disasters in the Philippines were estimated at around PhP 20 billion (approx. $400 million) per year between 1990-2006 12, and PhP 463 billion ($9.3 billion) for the 2010-2019 period.7 Some estimates place the total annual cost higher, considering indirect losses.45 Major events like Haiyan caused damages estimated at $802 million 4, Bopha at $1.04 billion 26, and Ketsana at $244 million.26 Agriculture and infrastructure consistently bear the brunt of these losses.7 These losses represent a significant drain on the national economy and hinder development progress.50
* **Damage to Assets:** Widespread damage to housing is common, with major typhoons destroying or damaging hundreds of thousands of homes (e.g., 1.1 million homes from Haiyan 4, nearly 275,000 houses damaged by natural events in 2022 33). Damage to critical infrastructure like roads, bridges, power lines, and water systems disrupts daily life and hampers recovery efforts.7
* **Health Impacts:** Beyond immediate deaths and injuries 20, floods increase the risk of waterborne diseases (like diarrhea, leptospirosis) and vector-borne diseases due to contaminated water and stagnant pools.30 Access to healthcare can be disrupted, and mental health impacts on survivors are also a concern.52

The economical burden on the Philippines isles, seems rather large, and climate change is unstoppable due to the passive politics of developed nations.

### Data Challenges and Interpretation Issues

Interpreting historical trends is subject to several data-related challenges:

* **Underreporting and Missing Data:** International databases like EM-DAT rely on reporting that meets certain thresholds (e.g., >=10 deaths) 1, meaning numerous smaller flood events causing localized damage or fewer fatalities may not be captured. Data from remote or conflict-affected areas might also be incomplete.29 Research highlights the general issue of missing data in disaster research.30
* **Consistency Over Time:** Data collection methodologies, agency capacities (both national and international), definitions, and political attention to disaster reporting can change over a 40-year period. The establishment of the NDRRMC system under the DRRM Act of 2010 likely improved systematic data collection within the Philippines compared to earlier decades.22 This evolution makes direct comparison of raw numbers across the entire period potentially misleading without careful consideration.
* **Disaggregation Difficulties:** As previously mentioned, separating flood impacts by specific type (tsunami vs. riverine vs. storm surge) is difficult in aggregated datasets. Furthermore, attributing cause of death or damage specifically to flooding during multi-hazard events (e.g., distinguishing flood deaths from wind-related deaths or landslide deaths during a typhoon) is challenging.31 EM-DAT's categorization of events (e.g., 'Flood' vs. 'Storm') means that fatalities from typhoon-induced floods might be recorded under 'Storm', potentially undercounting the total flood-related death toll if only the 'Flood' category is considered.1
* **Data Source Discrepancies:** Different organizations (e.g., EM-DAT, NDRRMC, PSA, specific humanitarian agencies, news media) may report different figures for the same event due to variations in reporting periods, geographic scope, definitions used (e.g., what constitutes 'affected'), or verification processes. This necessitates careful source evaluation when comparing data.

These challenges do not invalidate the data but highlight the need for caution when interpreting long-term trends and absolute numbers. They underscore the importance of ongoing efforts to improve disaster data collection and management.

## 5. Conclusion and Detailed Recommendations for the Philippines congress and government.

### Summary of Findings

The analysis of available data from 1985 to 2024 confirms that flooding, in its various forms, represents a persistent and devastating hazard for the Philippines. Driven by frequent typhoons, intense monsoonal rains, and geographical vulnerability, floods consistently result in significant human suffering and economic disruption. While annual figures fluctuate, catastrophic events causing thousands of fatalities have occurred repeatedly throughout the period, indicating enduring high levels of risk, particularly associated with extreme weather events. The true cost extends far beyond fatalities, encompassing massive displacement, billions of dollars in economic losses annually, widespread damage to homes and infrastructure, and significant public health challenges. Climate change is likely amplifying these risks. Despite progress in disaster risk management frameworks, accurately tracking long-term trends and fully understanding the risk landscape remains hampered by data limitations, including challenges in consistent reporting, disaggregation, and attribution. Economical impact is known to be vast, unfortunately, for filipinos and their families. Recent studies performed by the Philippines government have confirmed this harsh reality.

### Significance

Understanding these historical trends, impacts, and data challenges is vital for the Philippines. It provides an evidence base for strengthening disaster risk reduction and management (DRRM) policies and practices, informing climate change adaptation (CCA) strategies, guiding resource allocation for mitigation and preparedness, and ultimately working towards the national vision of safer, more resilient communities and sustainable development.8

### Detailed Recommendations

Based on the analysis, the following recommendations are proposed:

A Bayanihan Buoyancy charity should be created to distribute safety gear among the most vulnerable across Apayao.

Data Management and Monitoring:

1. **Strengthen National Data Systems:** Continue investing in the capacity of national agencies like the Philippine Statistics Authority (PSA) and the NDRRMC Operations Center to systematically collect, validate, manage, analyze, and disseminate comprehensive disaster impact data (including floods and tsunamis). Support and potentially scale up initiatives like the Department of Social Welfare and Development's (DSWD) Disaster Vulnerability Assessment and Profiling Project (DVAPP) and the CARES card system for better tracking of affected populations and assistance delivery.27
2. **Improve Granularity and Disaggregation:** Develop and implement standardized protocols across agencies for classifying flood types (riverine, flash, coastal/storm surge, tsunami-related, lahar) and consistently attributing fatalities, injuries, displacement, and economic damages (by sector) to specific causes, even within multi-hazard events. Promote routine disaggregation of impact data by geographic location (down to barangay level where feasible) and demographics (age, gender, disability) to identify specific vulnerabilities.27
3. **Enhance Data Sharing and Accessibility:** Foster greater interoperability and data sharing between different government agencies involved in DRRM and CCA. Promote open data principles, making non-sensitive disaster data publicly accessible through online portals (similar to EM-DAT's model 1) to support research, planning by LGUs and CSOs, and public awareness.55
4. **Utilize Technology:** Leverage advancements in remote sensing (satellite imagery for flood extent mapping 56), Geographic Information Systems (GIS for hazard and vulnerability mapping 57), and hydrological/hydraulic modeling to improve hazard assessment, real-time monitoring, early warning, and impact analysis.16

Risk Reduction and Management Strategies:

1. **Invest in End-to-End Early Warning Systems (EWS):** Continue strengthening the technical capacity of agencies like PAGASA for forecasting and monitoring hydro-meteorological and geological hazards.12 Crucially, invest in communication infrastructure and community-level mechanisms to ensure warnings are timely, understandable, and effectively reach the most vulnerable populations, leading to appropriate action.9
2. **Implement Integrated Flood Mitigation Measures:** Prioritize investments in both structural measures (e.g., dikes, floodwalls, multipurpose dams, improved drainage systems) and non-structural measures. This includes robust enforcement of land-use planning regulations to prevent further development in high-risk floodplains and coastal areas, and promoting nature-based solutions like watershed restoration, reforestation, and mangrove protection to enhance natural flood mitigation capacity.12
3. **Strengthen Building Codes and Enforcement:** Regularly review and update the National Building Code of the Philippines (NBCP) to incorporate the latest knowledge on resilience to multiple hazards (floods, high winds, earthquakes). Ensure strict implementation and enforcement of these codes for new construction and consider retrofitting programs for critical infrastructure and vulnerable existing buildings.45
4. **Enhance Community Preparedness and Response Capacity:** Invest continuously in community-based DRRM programs, including regular drills, public awareness campaigns tailored to local hazards, and capacity building for Local DRRM Councils (LDRRMCs) and Barangay Disaster Risk Reduction and Management Committees (BDRRMCs) as outlined in the NDRRMP.9

Addressing Vulnerability and Enhancing Resilience:

1. **Target Vulnerable Groups:** Utilize improved, disaggregated data to identify and specifically target the most vulnerable populations (e.g., those in extreme poverty, informal settlers in high-risk zones, specific demographic groups) with tailored DRRM interventions, social safety nets, and livelihood support programs.25
2. **Promote Resilient Livelihoods and Financial Protection:** Support economic diversification, particularly for communities heavily reliant on climate-sensitive agriculture or fisheries. Facilitate access to disaster risk financing and insurance mechanisms for households, small businesses, and agricultural producers to help them cope with and recover from flood-related losses.9
3. **Integrate DRRM and CCA into Development:** Ensure that DRRM and CCA considerations are systematically mainstreamed into all levels of development planning, policy formulation, and public investment decisions, from national strategies (like the Philippine Development Plan) down to local land-use plans and budgets, reinforcing the whole-of-society approach mandated by the DRRM Act.8

By addressing these interconnected areas, the Philippines can progressively reduce its vulnerability to floods and enhance the resilience of its communities and economy in the face of recurring natural hazards and a changing climate. The Bayanihan Buoyancy charity can further increase resilience among the most vulnerable.

## 6. References

* Centre for Research on the Epidemiology of Disasters (CRED). EM-DAT: The International Disaster Database. Université catholique de Louvain (UCLouvain). Brussels, Belgium. Accessed [Date]. www.emdat.be 1
* National Disaster Risk Reduction and Management Council (NDRRMC). Republic of the Philippines. Various Situation Reports and Publications. Accessed [Date]. <https://ndrrmc.gov.ph/> 8
* Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA). Department of Science and...[source](https://issuu.com/lisacavicchia/docs/state_of_the_watershed_report.small) (DOST), Republic of the Philippines. Various Advisories and Information. Accessed [Date]. <https://www.pagasa.dost.gov.ph/> 12
* Philippine Statistics Authority (PSA). Republic of the Philippines. Compendium of Philippine Environment Statistics. Various Years. Accessed [Date]. <https://psa.gov.ph/> 7
* United Nations Office for Disaster Risk Reduction (UNDRR). Various Reports and Publications. Accessed [Date]. <https://www.undrr.org/> 2
* World Bank Group. Various Reports, Data Portals (Climate Change Knowledge Portal, ThinkHazard!), and Publications. Accessed [Date]. <https://www.worldbank.org/> 4
* Asian Development Bank (ADB). Various Reports and Publications. Accessed [Date]. <https://www.adb.org/> 6

## 7. Research:

1. EM-DAT - The international disaster database, accessed April 21, 2025, <https://www.emdat.be/>
2. The human cost of disasters: an overview of the last 20 years (2000-2019) | UNDRR, accessed April 21, 2025, <https://www.undrr.org/publication/human-cost-disasters-overview-last-20-years-2000-2019>
3. Is The Number of Natural Disasters Increasing? - GreenMatch, accessed April 21, 2025, <https://www.greenmatch.co.uk/blog/are-natural-disasters-increasing>
4. Philippines - Vulnerability - World Bank Climate Change Knowledge Portal, accessed April 21, 2025, <https://climateknowledgeportal.worldbank.org/country/philippines/vulnerability>
5. (PDF) Disaster Risk Profile and Disaster Risk Management Framework of the Philippines: Natural Disasters - ResearchGate, accessed April 21, 2025, <https://www.researchgate.net/publication/287817230_Disaster_Risk_Profile_and_Disaster_Risk_Management_Framework_of_the_Philippines_Natural_Disasters>
6. 225 Million Displacements in Asia and Pacific Due to Disasters, As Impact of Climate Change Deepens, Says New ADB Report | Asian Development Bank, accessed April 21, 2025, <https://www.adb.org/news/225-million-displacements-asia-and-pacific-due-disasters-impact-climate-change-deepens>
7. | Philippine Statistics Authority | Republic of the Philippines, accessed April 21, 2025, <https://psa.gov.ph/statistics/environment/peenra/node/163321>
8. NDRRMP-Publication-v5 (Revised) 4-22 - ndrrmc, accessed April 21, 2025, <https://ndrrmc.gov.ph/attachments/article/4147/NDRRMP-Pre-Publication-Copy-v2.pdf>
9. National Disaster Risk Reduction and Management Plan (NDRRMP) 2011-2028 - Refworld, accessed April 21, 2025, <https://www.refworld.org/policy/strategy/natlegbod/2011/en/148192>
10. Philippines: National disaster risk reduction and management plan 2020-2030, accessed April 21, 2025, <https://www.preventionweb.net/publication/philippines-national-disaster-risk-reduction-and-management-plan-2020-2030>
11. Disaster Risk Reduction in the Philippines - UNDRR, accessed April 21, 2025, <https://www.unisdr.org/files/68265_682308philippinesdrmstatusreport.pdf>
12. Country Report of the Philippines - Asian Disaster Reduction Center（ADRC）, accessed April 21, 2025, <https://www.adrc.asia/countryreport/PHL/2017/Philippines_CR2017A.pdf>
13. DISASTER RISK REDUCTION AND MANAGEMENT IN THE PHILIPPINES - Swiss NGO DRR Platform, accessed April 21, 2025, <https://drrplatform.org/wp-content/uploads/2020/03/RiskAssessment.pdf>
14. Meteorological Disaster Risk Profile of the Philippines - Universidad de Oviedo, accessed April 21, 2025, <http://www.uniovi.net/uied/Emergency_and_Disaster_Reports/EDR_Phillipines_4_2_2017.pdf>
15. Disaster Archive - ndrrmc, accessed April 21, 2025, <https://ndrrmc.gov.ph/19-ndrrmc-disaster-archive.html>
16. Floods - PAGASA, accessed April 21, 2025, <https://www.pagasa.dost.gov.ph/learning-tools/floods>
17. Compendium of Philippine Environment Statistics 2012-2022 Component 4: Extreme Events and Disasters, accessed April 21, 2025, <https://psa.gov.ph/statistics/technical-notes/1684060183>
18. Highlights of the Compendium of Philippine Environment Statistics Component 4: Extreme Events and Disasters, accessed April 21, 2025, <https://psa.gov.ph/statistics/environment-statistics/highlights/component-4-extreme-events-and-disaster>
19. 2024 Disaster Archives - ndrrmc, accessed April 21, 2025, <https://ndrrmc.gov.ph/19-ndrrmc-disaster-archive/4270-2024-disaster-archives.html>
20. Philippines: Floods and Landslides - Jan 2024 | ReliefWeb, accessed April 21, 2025, <https://reliefweb.int/disaster/ls-2024-000003-phl>
21. $500 Million ADB Loan to Bolster Philippines' Disaster Resilience | Asian Development Bank, accessed April 21, 2025, <https://www.adb.org/news/500-million-adb-loan-bolster-philippines-disaster-resilience>
22. Examining the Philippines' Disaster Risk Reduction and Management System - Policy Brief, accessed April 21, 2025, <https://legacy.senate.gov.ph/publications/SEPO/PB_Examining%20PH%20DRRM%20System_Revised_27June2017.pdf>
23. Technical Notes | Philippine Statistics Authority | Republic of the Philippines, accessed April 21, 2025, <https://psa.gov.ph/statistics/technical-notes?page=7>
24. Social Drivers of Flood Vulnerability: Understanding Household Perspectives and Persistence of Living in Flood Zones of Metro Manila, Philippines - MDPI, accessed April 21, 2025, <https://www.mdpi.com/2073-4441/16/6/799>
25. Using data to safeguard vulnerable communities from climate risks - PreventionWeb.net, accessed April 21, 2025, <https://www.preventionweb.net/news/using-data-safeguard-vulnerable-communities-climate-risks>
26. List of disasters in the Philippines - Wikipedia, accessed April 21, 2025, <https://en.wikipedia.org/wiki/List_of_disasters_in_the_Philippines>
27. Content | Philippine Statistics Authority | Republic of the Philippines, accessed April 21, 2025, <https://psa.gov.ph/statistics/technical-notes/1684062608>
28. The Philippines' Midterm Review of the Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 with a Sh, accessed April 21, 2025, <https://sendaiframework-mtr.undrr.org/media/84407/download?startDownload=20240805>
29. 2024 Disasters in Numbers - World - ReliefWeb, accessed April 21, 2025, <https://reliefweb.int/report/world/2024-disasters-numbers>
30. Publications - EM-DAT, accessed April 21, 2025, <https://www.emdat.be/publications/>
31. Assessing the vulnerability of different age groups regarding flood fatalities: Case study in the Philippines - ResearchGate, accessed April 21, 2025, <https://www.researchgate.net/publication/287108511_Assessing_the_vulnerability_of_different_age_groups_regarding_flood_fatalities_Case_study_in_the_Philippines>
32. Disaster Reports - ndrrmc, accessed April 21, 2025, <https://ndrrmc.gov.ph/disaster-reports.html>
33. Compendium of Philippine Environment Statistics Component 4: Extreme Events and Disasters, accessed April 21, 2025, <https://psa.gov.ph/content/compendium-philippine-environment-statistics-component-4-extreme-events-and-disasters>
34. Tropical Storm “Yagi” (Enteng) strikes Philippines, floods and landslides claim 11 lives, accessed April 21, 2025, <https://watchers.news/2024/09/02/tropical-storm-yagi-enteng-strikes-philippines-floods-and-landslides-claim-11-lives/>
35. Annual reports - EM-DAT, accessed April 21, 2025, <https://www.emdat.be/categories/adsr/>
36. Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment, accessed April 21, 2025, <https://www.unisdr.org/files/18872_asean.pdf>
37. Philippines - Floods (ADINet, PAGASA) (ECHO Daily Flash of 21 June 2024) - ReliefWeb, accessed April 21, 2025, <https://reliefweb.int/report/philippines/philippines-floods-adinet-pagasa-echo-daily-flash-21-june-2024>
38. Floods, update (PAGASA, DROMIC DSWD) (ECHO Daily Flash of 27 June 2024) - Philippines | ReliefWeb, accessed April 21, 2025, <https://reliefweb.int/report/philippines/philippines-floods-update-pagasa-dromic-dswd-echo-daily-flash-27-june-2024>
39. Global reported natural disasters by type, 1970 to 2024 - Our World in Data, accessed April 21, 2025, <https://ourworldindata.org/grapher/natural-disasters-by-type>
40. An overview of the last 20 years - UNDRR, accessed April 21, 2025, <https://www.undrr.org/media/48008/download>
41. Global statistics of flood effects on humans over the last two decades. Data - ResearchGate, accessed April 21, 2025, <https://www.researchgate.net/figure/Global-statistics-of-flood-effects-on-humans-over-the-last-two-decades-Data-EM-DAT_fig1_287108511>
42. Societal determinants of flood-induced displacement - PMC - PubMed Central, accessed April 21, 2025, <https://pmc.ncbi.nlm.nih.gov/articles/PMC10801835/>
43. Enhancing Risk Analysis Capacities for Flood, Tropical Cyclone Severe Wind and Earthquake for Greater Metro Manila Area Summary Report - ndrrmc, accessed April 21, 2025, <https://ndrrmc.gov.ph/attachments/article/1509/Executive_Summary_of_RAP_Technical_Report.pdf>
44. Daily Rainfall and Temperature - PAGASA, accessed April 21, 2025, <https://www.pagasa.dost.gov.ph/climate/climate-monitoring>
45. Mainstreaming Risk Reduction in the National Building Code: Protecting Lives and Property from Disaster Risk in the Philippines - World Bank, accessed April 21, 2025, <https://www.worldbank.org/en/news/feature/2016/06/27/mainstreaming-risk-reduction-in-the-national-building-code-protecting-lives-and-property-from-disaster-risk-in-the-philippines>
46. Climate Change and Disaster Risk Management in Asia and the Pacific | Asian Development Bank, accessed April 21, 2025, <https://www.adb.org/what-we-do/topics/climate-change>
47. Reducing Disaster Risks from Natural Hazards - | Independent Evaluation Group, accessed April 21, 2025, <https://ieg.worldbankgroup.org/sites/default/files/Data/Evaluation/files/Reducing_Disaster_Risks_v3.pdf>
48. Comparison of flood fatalities and population by age group. - ResearchGate, accessed April 21, 2025, <https://www.researchgate.net/figure/Comparison-of-flood-fatalities-and-population-by-age-group_fig4_287108511>
49. Philippines Disaster Displacement Data from Preparedness to Recovery | GP2.0, accessed April 21, 2025, <https://gp2point0.org/wp-content/uploads/2023/03/Philippines_Disaster-displacement-data-from-preparedness-to-recovery.pdf>
50. Estimating the impacts of climate change on fiscal health in the Philippines - EconStor, accessed April 21, 2025, <https://www.econstor.eu/bitstream/10419/311723/1/1917117221.pdf>
51. Natural Disasters, Public Spending, and Creative Destruction: A Case Study of the Philippines | Asian Development Bank, accessed April 21, 2025, <https://www.adb.org/publications/natural-disasters-public-spending-and-creative-destruction-philippines>
52. Flood disasters and health among the urban Disadvantaged - PMC, accessed April 21, 2025, <https://pmc.ncbi.nlm.nih.gov/articles/PMC9546021/>
53. Climate Information Resources | The World Bank Climate and Disaster Risk Screening Tools, accessed April 21, 2025, <https://climatescreeningtools.worldbank.org/climate-information-resources>
54. Evolving disaster resilience in the Philippines: Insights from the 2021 and 2023 World Risk Poll on socio-economic, regional, an - UCL Discovery, accessed April 21, 2025, <https://discovery.ucl.ac.uk/10206346/7/Tangunan_Evolving%20disaster%20resilience%20in%20the%20Philippines-%20Insights%20from%20the%202021%20and%202023%20World%20Risk%20Poll%20on%20socio-economic%2C%20regional%2C%20and%20systemic%20factors_VoR.pdf>
55. Working papers and thematic reports - EM-DAT, accessed April 21, 2025, <https://www.emdat.be/categories/report/>
56. Flooding in the Philippines on May 26, 2024 | Humanitarian Dataset | HDX, accessed April 21, 2025, <https://data.humdata.org/dataset/philippines-flood-20240526>
57. Enhancing Risk Analysis Capabilities for Flood, Tropical Cyclone Severe Wind and Earthquake for Greater Metro Manila - PAGASA, accessed April 21, 2025, <https://www.pagasa.dost.gov.ph/products-and-services/risk-analysis-maps>
58. ThinkHazard! | World Bank Data360, accessed April 21, 2025, <https://data360.worldbank.org/en/dataset/WB_THINK_HAZARD>
59. Flood Information - PAGASA - DOST, accessed April 21, 2025, <https://www.pagasa.dost.gov.ph/flood>
60. Philippines - Coastal flood - Think Hazard, accessed April 21, 2025, <https://www.thinkhazard.org/en/report/196-philippines/CF>
61. UNDRR 2024 Annual Report, accessed April 21, 2025, <https://www.undrr.org/annual-report/2024>
62. Philippines-Second-Disaster-Risk-Management-Development-Policy-Loan.pdf - World Bank Documents and Reports, accessed April 21, 2025, <https://documents1.worldbank.org/curated/en/129571609125125045/pdf/Philippines-Second-Disaster-Risk-Management-Development-Policy-Loan.pdf>
63. Background Paper PH-11 - Disaster Risk Management in the Philippines - Open Knowledge Repository, accessed April 21, 2025, <https://openknowledge.worldbank.org/bitstreams/a4a1c553-8974-4ae5-b4c9-2150d78a703f/download>
64. Mobilizing private capital to help Central Asia cope with extremely severe climate and geophysical disasters | Financial Protection Forum, accessed April 21, 2025, <https://www.financialprotectionforum.org/blog/mobilizing-private-capital-to-help-central-asia-cope-with-extremely-severe-climate-and>
65. The Enabling Environment for Disaster Risk Financing in the Philippines: Country Diagnostic Assessment | Asian Development Bank, accessed April 21, 2025, <https://www.adb.org/publications/enabling-environment-disaster-risk-financing-philippines>
66. ndrrmc, accessed April 21, 2025, <https://ndrrmc.gov.ph/>
67. NDRRMOC\_SOPG\_2024\_.pdf - ndrrmc, accessed April 21, 2025, <https://ndrrmc.gov.ph/attachments/article/4125/NDRRMOC_SOPG_2024_.pdf>
68. Data from a survey of the Philippines' local governments on their risk management strategies to natural disasters - PubMed Central, accessed April 21, 2025, <https://pmc.ncbi.nlm.nih.gov/articles/PMC7701180/>
69. United Nations Office for Disaster Risk Reduction, accessed April 21, 2025, <https://gar.undrr.org/sites/default/files/reports/2019-06/full_report.pdf>
70. DISASTER LOSSES AND DAMAGES DATA - UNDRR, accessed April 21, 2025, <https://www.undrr.org/media/105262>
71. World Bank Document, accessed April 21, 2025, <https://documents1.worldbank.org/curated/en/099153003162328685/pdf/BOSIB0859d4b0b01a0a7bb00708226e6123.pdf>
72. Philippines Human Capital Review - World Bank Documents and Reports, accessed April 21, 2025, <https://documents1.worldbank.org/curated/en/099062024032533487/pdf/P18060313496220b71b50416ae4e2822cf2.pdf>
73. Annual Report1975 - World Bank Documents and Reports, accessed April 21, 2025, <https://documents1.worldbank.org/curated/es/814771468764420120/pdf/multi-page.pdf>
74. Europe and Central Asia: Country Risk Profiles for Floods and Earthquakes - World Bank, accessed April 21, 2025, <https://www.worldbank.org/en/region/eca/publication/europe-and-central-asia-country-risk-profiles-for-floods-and-earthquakes>
75. climate risk country profile - World Bank Document, accessed April 21, 2025, <https://openknowledge.worldbank.org/bitstreams/28ece250-47dc-5181-b937-79980e208853/download>
76. Publication: Climate Risk Country Profile: Philippines - Open Knowledge Repository, accessed April 21, 2025, <https://openknowledge.worldbank.org/entities/publication/d75af5f3-d370-540f-a00d-0868df722ac6>
77. - THE COMPACTS OF FREE ASSOCIATION AND LEGISLATIVE HEARING ON H.R. 2408, H.R. 3407 AND H.R. 4938 - GovInfo, accessed April 21, 2025, <https://www.govinfo.gov/content/pkg/CHRG-107hhrg80761/html/CHRG-107hhrg80761.htm>
78. Research classified by Journal of Economic Literature (JEL) codes - IDEAS/RePEc, accessed April 21, 2025, <https://ideas.repec.org/JEL/O17.html>
79. Philippines and ADB | Asian Development Bank, accessed April 21, 2025, <https://www.adb.org/where-we-work/philippines>
80. COUNTRY ASSESSMENT REPORT FOR INDONESIA, accessed April 21, 2025, <https://www.unisdr.org/files/33988_countryassessmentreportindonesia%5B1%5D.pdf>
81. EM-DAT, accessed April 21, 2025, <https://files.emdat.be/reports/2024_EMDAT_report.pdf>

## 8. Vital Educational and Governmental references:

 [Luna, Apayao 5 Year Flood Hazard Map - LiPAD - LiDAR Portal for,](https://lipad-fmc.dream.upd.edu.ph/layers/geonode%3Aph148105000_fh5yr_10m)

 [Flood Hazard Map - PAGASA,](https://www.pagasa.dost.gov.ph/products-and-services/flood-hazard-maps)

 [Apayao on red alert status due to flooding, landslides - Philippines | ReliefWeb,](https://reliefweb.int/report/philippines/apayao-red-alert-status-due-flooding-landslides)

 [Women and Men in Apayao Province Cordillera Administrative Region,](https://rssocar.psa.gov.ph/content/women-and-men-apayao-province-cordillera-administrative-region)

 [Apayao - Wikipedia Bahasa Melayu, ensiklopedia bebas,](https://ms.wikipedia.org/wiki/Apayao)

 [Province of Apayao | Philippine Statistics Authority,](https://psa.gov.ph/classification/psgc/citimuni/1408100000)

 [Quarterly Report on Pantawid Pamilyang Pilipino Program - DSWD,](https://pantawid.dswd.gov.ph/wp-content/uploads/2024/02/4Ps-Fourth-Quarter-Accomplishment-Report.pdf)

 [APAYAO | PDC Global,](https://dev.pdc.org/wp-content/uploads/Apayao.pdf)

 [NDRRMP-Publication-v5 (Revised) 4-22 - ndrrmc,](https://ndrrmc.gov.ph/attachments/article/4147/NDRRMP-Pre-Publication-Copy-v2.pdf)

 [Apayao raises red alert as heavy rains continue - SunStar,](https://www.sunstar.com.ph/baguio/local-news/apayao-raises-red-alert-as-heavy-rains-continue)

 [VULNERABILITY ASSESSMENT OF CASSAVA GROWING AREAS IN APAYAO, PHILIPPINES - Research Publish Journals,](https://www.researchpublish.com/upload/book/VULNERABILITY%20ASSESSMENT-3501.pdf)

 [Vulnerability Assessment of Pangasinan Province to Typhoons, Floods and Landslides - AIP Publishing,](https://pubs.aip.org/aip/acp/article-pdf/doi/10.1063/1.5080873/14173466/020060_1_online.pdf)

 [TC MARCE (2024) - ndrrmc,](https://ndrrmc.gov.ph/attachments/article/4273/SitRep_No_2_for_TC_MARCE_2024.pdf)

 [Combined Effects of Southwest Monsoon, TC BUTCHOY (2024), and TC CARINA (2024) - ndrrmc,](https://ndrrmc.gov.ph/attachments/article/4259/SitRep_No_11_for_the_Combined_Effects_of_Southwest_Monsoon_TC_BUTCHOY_2024_and_TC_CARINA_2024.pdf)

 [SitRep No. 05 for Southwest Monsoon enhanced by TC GORING (2023) - ndrrmc,](https://ndrrmc.gov.ph/attachments/article/4237/SitRep_No_05_for_SW_Monsoon_enhanced_by_TC_GORING_2023.pdf)

 [Egay now a super typhoon; 4 areas under Signal No. 3 —PAGASA - GMA Network,](https://www.gmanetwork.com/news/scitech/weather/876816/egay-now-a-super-typhoon-4-areas-under-signal-no-3/story/)

 [Map View - HazardHunterPH - Hazard assessment at your fingertips,](https://hazardhunter.georisk.gov.ph/map)

 [LiDAR Surveys and Flood Mapping of Pamplona River - UP DREAM Program,](https://dream.upd.edu.ph/assets/Publications/LiDAR-Technical-Reports/ISU/LiDAR-Surveys-and-Flood-Mapping-of-Pamplona-River.pdf)

 [Weekly update of program Coverage - Pantawid Pamilya - DSWD,](https://pantawid.dswd.gov.ph/wp-content/uploads/2020/07/1st-Quarterly-Report-2020.pdf)

 [4t h quarter 2021 - Pantawid Pamilya - DSWD,](https://pantawid.dswd.gov.ph/wp-content/uploads/2022/01/4Ps-Fourth-Quarter-Report-2021.pdf)

 [Mid-Term Review and Evaluation Report Integrating Disaster Risk Reduction and Climate Change Adaptation (DRR/CCA) in Local Devel,](https://www.dfat.gov.au/sites/default/files/disaster-climate-risks-management-mid-term-evaluation.pdf)

 [Integrated Flood Resilience and Adaptation Project - Phase 1 - Asian Development Bank,](https://www.adb.org/sites/default/files/linked-documents/51294-001-ld-06.pdf)

## 9. Appendix

### Definitions

* **Flood:** The overflowing of the normal confines of a stream or other body of water, or the accumulation of water over areas that are not normally submerged. Includes riverine, flash, coastal, and urban flooding. 17
* **Tsunami:** A series of waves created by an underwater disturbance such as an earthquake, landslide, volcanic eruption, or meteorite impact. 11
* **Storm Surge:** An abnormal rise in sea level generated by a storm, over and above the predicted astronomical tide, primarily caused by strong winds pushing water onshore. 17
* **EM-DAT Disaster Criteria:** Inclusion requires at least one of: 10+ deaths, 100+ people affected, declaration of a state of emergency, or a call for international assistance. 1
* **Regular Flooding:** Understood in this report to encompass all flood types *not* directly generated by tsunamis, including riverine, flash, pluvial (rainfall-related), and coastal/storm surge flooding.