

The Philippines, between 1985-2015, has experienced 410 natural disasters which led to over 40,000 deaths and \$23 billion worth of damages. During disasters, the Philippine government carries majority of the burden in recovering from losses and in rehabilitating impacted communities. Most of this work is performed at the local level. It is more difficult for local government units (LGUs) that belong to the lower income classes because they have less financial resources, and yet they are also among the more vulnerable to disaster. The consequent fiscal vulnerability can be decreased by means of disaster risk financing and *ex ante* or preventive measures such as insurance. However, given the absence of policy requiring insurance availment for 2<sup>nd</sup> to 6<sup>th</sup> income class municipalities, there is currently a low take-up of insurance among them. This is partly attributed to low awareness of the need, the cost, and the possible financing sources and options. In line with the foregoing, the MINDER Project aimed to design a viable insurance program for 3<sup>rd</sup> to 6<sup>th</sup> income class municipalities by looking at feasible (market, financial and technical) insurance options (e.g. traditional vs. parametric).

## SUMMARY OF FINDINGS AND RECOMMENDATIONS

- 1. Raise awareness among LGUs on insurance based on vulnerabilities.** There is low availment of appropriate insurance among 4<sup>th</sup> to 6<sup>th</sup> income class municipalities that considers their vulnerabilities. This is attributed to low awareness on the need for insurance, its subsequent benefits, cost and possible financing sources.
- 2. The use of the local DRRM fund could be explored, before finding other external funding sources.** Findings suggest that there are unspent balances under the pilot LGUs' DRRM fund, which could instead be used to fund their disaster insurance. Its adequacy would depend on the number of their critical facilities, and their other DRRM projects.
- 3. Strengthen interoperability of climate information systems with local government users.** Optimizing the identification of facilities that need to be insured that also matches optimum coverage to its vulnerabilities require better access to information among LGUs. Some of these information are already available with national agencies, while others need to be collected more systematically by LGUs.
- 4. Viability of parametric insurance is a work in progress.** Current data gaps prevent the modeling of a parametric or index-based insurance for typhoons and disasters. Filling this gap would require a systematical collection of 5-year data on loss and damage, wind speed and rainfall amount, which participating pilot LGUs should collect.

## THE RESEARCH

### I INTRODUCTION

With the aim of designing a viable insurance product for 3<sup>rd</sup> to 6<sup>th</sup> income class municipalities, this study investigated the **market, financial, and technical feasibility** of perfecting an insurance model. This study conducted a survey with 2<sup>nd</sup> to 6<sup>th</sup> income class municipalities, ran key informant interviews and collected relevant documents from selected pilot municipalities such as Iguig, Cagayan; Zarraga, Iloilo; Salcedo and Quinapondan, Eastern Samar; Jabonga, Agusan del Norte; and Marihatag, Surigao del Sur. This study also looked into insurance data provided by the Government Service Insurance System (GSIS) for 2<sup>nd</sup> to 6<sup>th</sup> class municipalities for the time period 2016-2017, loss and damage data provided by the Office of Civil Defense (OCD) and selected LGUs, climate data provided by UP Resilience Institute (UP RI) NOAA Center, and other relevant government documents and literature.

### II MARKET FEASIBILITY

All government offices, except 2<sup>nd</sup> to 6<sup>th</sup> income class municipalities, are mandated by the Property Insurance Law (RA 656) to avail of insurance from its mandated government insurance provider, the Government Service Insurance System. This exception leaves the availment of 2<sup>nd</sup> to 6<sup>th</sup> class municipalities to their own discretion, such that 4<sup>th</sup> to 6<sup>th</sup> income class municipalities have apparent lower insurance take-up, with poorer LGUs less likely to be insured. Figure 1 shows the decreasing trend of insurance availment down the income classes.

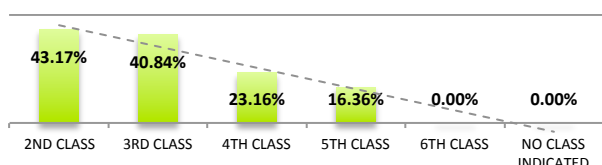


Figure 1. Insurance Availment Rate among Municipalities by Income Class.

In line with this, the findings of this study suggest that among the factors that result to low insurance availment are low appreciation and the lack of awareness among LGUs regarding its importance, benefits, and cost, as well as perceived unaffordability. These contribute to insurance being less prioritized as it competes with other programs and projects that need to be financed by local funds.

While higher insurance availment rates are ideal, these do not automatically translate to optimum coverage. Infrastructure critical to the operations of the municipalities must be primarily insured, while considering that the perils covered coincide with the municipalities' local exposure and vulnerabilities. Given that the minimum coverage for peril insured is fire and lightning, all properties that the municipalities have insured are assumed to be covered against this peril. However, based on the National Disaster Risk Reduction and Management Plan 2011-2028, the most frequently occurring hazards in the country are typhoons and floods. This suggests that there is a probable disconnect between the minimum insurance coverage and the disasters experienced by the LGUs. Figure 2 shows that out of the currently insured properties, a large percentage of these are yet to be insured against typhoons and flood, given the current insurance coverage of 60.53% and 58.18% against these two perils respectively.

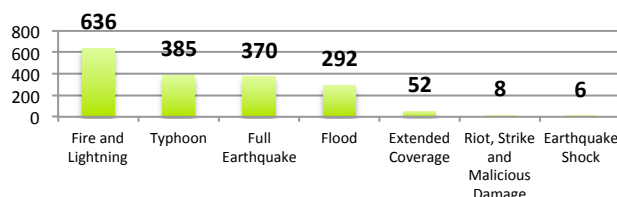
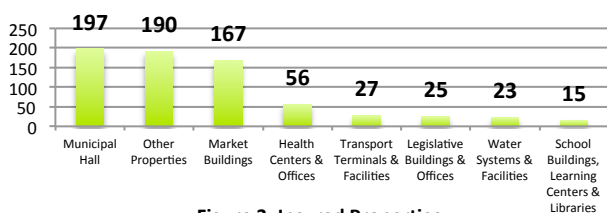


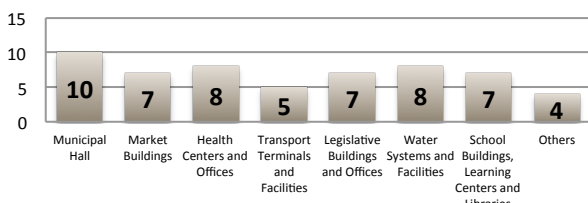
Figure 2. Insured Properties by Peril/s Covered.



**Figure 3. Insured Properties.**

Most of the insured municipalities insure their municipal halls and market buildings (see Figure3). Municipal halls are considered as a critical facility for it is where most of the local government operations originate. Out of the six pilot LGUs, three have already availed of insurance for the time period 2016 – 2017. Iguig has insured its pump houses and water tanks only against fire and lightning at Php 15,987.14 for Php 2,505,822.05 coverage. Iguig added that they also started insuring their slaughterhouse against fire and lightning, since it was part of the condition of an external funder. Whereas, Jabonga has insured several properties including its old and new municipal halls, training center, and regional health unit against fire and lightning, typhoon, flood, full earthquake at a premium amount of Php 154,884.33 for a total of Php 25,937,433.00 coverage. Last, Salcedo has also insured its municipal hall against the aforesaid perils at Php 134,061.71 for a Php 18,585,669.35 coverage. The municipality of Salcedo started insuring at least its municipal hall upon learning about the Php 11,843,000.00 payout that Guiuan, Eastern Samar was able to claim during typhoon Yolanda in 2013. KII findings also suggest that some of the municipalities appropriately located some of their critical facilities on areas that are not flood-prone, to reduce the risk of damage.

On the other hand, municipalities that are yet to insure their facilities expressed interest in insuring the following properties (see Figure 4). Other properties that they want to insure include local government-owned farm-to-market roads; dikes; government lots; sanitary landfills; Roll-on, Roll-off (RoRo) ports; fish ports and landings; covered courts and amphitheatres.



**Figure 4. Properties municipalities would like to insure.**

### III FINANCIAL FEASIBILITY

The cost of insuring facilities for LGUs (for traditional insurance) is dependent on the number and kind of facilities they indemnify, the perils they insure against and the level of risk which affects the possibility of payout. The premium cost is generally computed based on the assessed replacement cost of a property in case of damage (or the total sum insured) and its exposure and vulnerability to certain risks, among other factors.

The insurance data on 2<sup>nd</sup> to 6<sup>th</sup> income class municipalities provided by GSIS shows the total amount that LGUs could claim as payout for the certain amount of premium that they have paid covering varying types of perils. The limitation on the provided data was that for some LGUs that insured several properties, whereby the total sum insured (TSI) and premium amounts for their properties were aggregated. Given that the most insured property were municipal halls, for the purpose of comparison, only those data which indicated the TSI and premium for municipal halls alone were extracted.

The varying levels of risks for the different locations of the properties were not considered in these approximations. Moreover, the averages taken, are only an indicative illustration of the differences in the amounts, since these may have been affected by the high and low premium and TSI values. Following the aforesaid premise, Table 1 summarizes the average premium cost and amount of coverage for some of the different combinations of perils. The average percentage of premium over TSI shows the portion of amount that an LGU would shoulder for an equivalent amount of expected payout. Coverage for additional perils would entail average differences of 0.06% for typhoon and 0.19% for both typhoon and flood. With additional perils covered, the average premium increases, while the average TSI decreases. But considering the increased likelihood of the additional perils, the added expenditure may be deemed acceptable.

Type of Perils	Average Premium	Average Total Sum Insured (TSI)	Average Percentage (Premium/TSI)
Fire and Lightning	67,287.67	17,101,540.07	0.42%
Fire and Lightning, Typhoon	106,827.04	20,707,648.32	0.48%
Fire and Lightning, Typhoon, Flood	86,843.61	12,005,465.75	0.67%

**Table 1. Average Premiums and Total Sum Insured of Municipal Halls for Different Combinations of Perils (in Php).**

On the other hand, Table 2 summarizes the average amount of premium and TSI for the different properties that LGUs insure, with the percentage of premium over TSI in decreasing order. However, due to data limitation, these averages do not reflect the differences in the combinations of perils covered similar to Table 1.

Insured Property	Average Premium	Average Total Sum Insured (TSI)	Average Percentage (Premium/TSI)
Market Buildings	197,747.05	12,256,988.31	1.72%
Transport Terminals and Facilities	131,025.24	13,119,805.61	1.01%
Legislative Buildings and Offices	52,862.23	7,958,827.21	0.70%
Health Centers and Offices	88,876.55	10,725,774.13	0.69%
Municipal Hall	96,434.19	15,417,983.68	0.63%
School Buildings, Learning Centers and Libraries	44,158.31	6,247,491.56	0.55%

**Table 2. Average Premiums and Total Sum Insured of Different Insured Properties (in Php).**

Survey results show that the source of insuring for some LGUs include their general fund, maintenance and other operating expenses, insurance expense and their DRRM Fund. Only one of the respondents said that they charged insurance to their DRRM fund, when in fact it is considered as one of the expenditure items allowed under this fund.

Currently, in recovering from disasters, the pilot LGUs specified that the funds are sourced out internally (from their own DRRM fund) and externally (from the provincial and national government and international donors). These LGUs also indicated typhoon and flooding as their most commonly experienced disasters and expressed interest in insuring their critical facilities, but cited their limited budget and other priority programs as hindrance for financing it.. Table 3 shows the appropriated budgets of the pilot LGUs for DRRM based on 2016 COA Audit Reports. These DRRM funds of the pilot LGUs are, on average, Php 4,618,813.28

LGU	Income Class	2016 Local DRRM Budget (in Php)
Iguig	4th class	6,493,699.60
Zarraga	4th class	5,574,520.06
Salcedo	5th class	3,528,320.60
Quinapondan	5th class	2,827,884.35
Jabonga	3rd class	4,793,881.05
Marihatag	3rd class	4,494,574.00

**Table 3. 2016 Appropriated DRRM Funds of the Pilot LGUs.**

Local DRRM funds constitute 5% of the total budget of local government units, 30% of which could be utilized for quick response and 70% for disaster risk reduction and mitigation. According to 2016 Commission on Audit Reports, some of the pilot LGUs have unspent balances under their LDRRM funds – Iguig has Php 1,805,471.00, Quinapondan has Php 6,506,163.09 (Php 2,340,139.00 from that year's appropriations and Php 4,166,024.08 from previous years), and Jabonga has Php 2,010,500.40. Unspent balances must be secured in a trust fund that could be used for the same purpose for five years.

These findings suggest that it may be the case that although low income class municipalities may have lesser budgets, proper utilization of their existing funds and prioritization of significant projects with beneficial outcomes can still be carried out. Nonetheless, these figures do not guarantee that the local DRRM funds of the pilot municipalities would be adequate to cover the entire premium expenditure for disaster insurance. Hence, the need for other possible sources of financing or external funding would largely depend on the number of vulnerable facilities they intend to insure and the other DRRM projects that need to be executed.

The sentiment of some respondents from the pilot LGUs regarding insurance was that availing it seems like addressing problems that are yet to occur, even as there may be more urgent concerns that need to be immediately confronted. On the contrary, the principle of insurance is dealing with unforeseen financial obligations with less difficulty in times of disasters, since the expected post-disaster expense has already been included in the budget and is distributed across time.

If provided with the capability to assess their local vulnerabilities and information regarding the likelihood of the occurrence of disasters, seeking insurance for critical facilities, mindsets of local chief executives can be changed so that insurance is viewed as an investment, rather than taking a chance. To illustrate, Salcedo's municipal hall during typhoon Yolanda entailed them a repair cost of Php 5,000,000.00. This could have been avoided or minimized had they availed of insurance then, given that the Php 134,061.71 premium they have paid for in the time period 2016-2017 already covers for a total sum insured of Php 18,585,669.35.

#### IV TECHNICAL FEASIBILITY

This study also aimed to model a parametric insurance for typhoons and floods (see Annex A). This type of insurance correlates the amount of losses to an index or a set of values, such that a set amount is paid out in case the index is reached. It is an alternative insurance model being considered in lieu of the traditional one GSIS provides and is described above.

Parametric insurance payouts, unlike those of traditional insurance, are not based on individual loss adjustments, but are determined according to the measurement of a highly correlated index. For the case of typhoons and flooding, rainfall amount (in mm) and wind speed (in kph) may be used as indices (see Annex B).

Although there are some existing models from the literature that is based on other country experiences, the most optimum model should ideally be based on information that is contextually taken. A recent pilot in Bangladesh, for instance, found that limited flood loss data and flood hazard models at present still make it difficult to calculate the risks and determine the premium for any such insurance scheme.

As such, the development of this insurance model in the Philippines, especially in the context of vulnerabilities LGUs are most exposed to, require more data on rainfall and wind speed on the location of the properties for a minimum period of five (5) years. Consequently, these would be correlated with the properties' loss and damage data during the same period. The availability of these information (see Annex C) stands as follows. Limitations on the availability of these requires dedicated information system resources (human and equipment) that would take some time (minimum of 5 years of data) and commitment among stakeholders (e.g. LGU, OCD, PAGASA, UP RI) to build.

#### V NEXT STEPS

Given the low availment rate among 2<sup>nd</sup> to 6<sup>th</sup> income class municipalities, there is a need to raise awareness among LGUs regarding insurance based on their local vulnerabilities. LGUs must be informed on the need for insurance, its subsequent benefits, cost and possible financing sources. LGUs could start considering availing of traditional insurance using their internal DRRM fund. If inadequate, external funding sources (provincial and national government, international donors) and financing mixes could be explored.

On the other hand, there is also a need to strengthen the interoperability of climate information systems with local government users. The identification of facilities that need to be insured that also matches optimum coverage to its vulnerabilities require better access to information among LGUs. Moreover, the current climate and disaster risk assessments (CDRA) of the pilot sites and LGUs in general differ in their levels of complexity, depending on the agency or organization that assisted the LGUs during its formulation. It would be better if there is a more standardized process of formulating the CDRA for the case of LGUs, while thorough technical assistance and capability building are provided to them by the concerned national agencies. This would not only help in the identification of critical facilities for insurance, but would also help in the formulation of their Local Disaster Risk Reduction and Management Plan, as well as their Local Climate Change Action Plan.

While this study aimed to design a viable insurance model for typhoons and floods, current data gaps prevent this study from perfecting the model. Filling this gap would require a systematical collection of 5-year data on loss and damage, wind speed and rainfall amount, which participating pilot LGUs should begin to collect, with the assistance of mandated national agencies. In the meantime, while the 5-year data collection is ongoing, this study could engage its pilot LGUs to seek traditional insurance against typhoons and floods for their critical facilities. During this period, the viability of the parametric insurance model could be tested by simulating how the parametric insurance payouts would have worked in comparison to the pilot LGUs' experience with the traditional mode of insurance. Only when the required data has been completed and the viability of this model has been tested, can the piloting of this parametric insurance model for typhoons and flooding be carried out.

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## ANNEX A

### Parametric Insurance Model for Typhoons and Floods

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The insurance model proposed by the MINDER Project is a parametric insurance model taking as index a combination of both the amount of rainfall and wind speed in a particular location over a particular span of time.

Parametric insurance is an insurance model wherein the losses of the insured are correlated to an index (a set of values), e.g. rainfall in millimeters, and a set amount is paid out if that index is reached. The index can be measured via weather stations or, increasingly, satellite images, making parametric insurance one of the most innovative, affordable and fitting solutions for weather-sensitive companies and populations<sup>i</sup>.

Parametric insurance payouts, unlike traditional insurance models, are not based on individual loss adjustments, but are determined according to the measurement of a highly correlated index. Therefore, there is the potential for a mismatch between parametric insurance claims settlement and the actual losses of the insured, which is generally referred to as basis risk<sup>ii</sup>.

Amount of rainfall and wind speed were chosen as index components since the goal of the insurance model is to insure

damages against certain public properties in the event of typhoons and flooding. From Philippine weather agencies such as PAGASA, these aforementioned components are the most publicized, and further one can easily and logically link a higher amount of property damage with a higher rainfall and wind speed measurement.

Parametric insurance models taking into consideration the amount of rainfall are already being used in crop insurance policies<sup>iii,iv,v</sup>. In the context of typhoons and flooding, an 'excess rainfall' insurance policy has been sold by the Caribbean Catastrophe Risk Insurance Facility as early as 2014<sup>vi,vii,viii</sup> as protection to government properties under the risk of severe rainfall. There is also research on correlations of rainfall data and insurance damage data<sup>ix</sup>, one in particular takes note of a weak relationship between property damage and rainfall intensities in specific case scenario<sup>x</sup>.

Meanwhile, studies focusing in the correlation of high wind speeds and occurrence of insurance claims (whether property, or crop policies) gives insight as to how this index value could possibly affect the proposed insurance model<sup>xi,xii</sup>.

#### Parametric Insurance Payout Computation

The public storm warning system will be the basis for the amount of wind speed incurred by the area. While the rainfall advisory by PAGASA will be the basis of the amount of rainfall. Since the index considered two factors: wind speed and amount of rainfall, the table below will show a hypothetical scenario of payout for a given property with value of 1,000 PhP.

Windspeed (k) / rainfall (r)	30-60 kph	61-100 kph	101-185 kph	186-220 kph	Above 220 kph
< 2.5 mm	0		$\frac{k-60}{160} * 1000$		1000
2.5 – 7.5 mm	$\frac{r-2.5}{27.5} * 500$	$\left(\frac{r-2.5}{27.5}\right) \left(1000 - \frac{k-60}{160} * 1000\right) + \frac{k-60}{160} * 1000$	$\frac{k-60}{160} * 1000$		1000
7.5 – 15 mm					1000
15 – 30 mm					1000
Above 30 mm	500		$\frac{k-60}{160} * 500 + 500$		1000

It was assumed that if the wind speed reached 220 kph, the property being considered will experience total damage, whatever the amount of rainfall is. On the other hand, if the rainfall amount reached 30 mm, the property will receive a minimum of 500 PhP. The insured will not receive any payout if the amount of wind speed is below 60 kph and the amount of rainfall is below 2.5 mm. The insured will receive a payout based on the table given above.

**Illustration 1:** Suppose a building amounting to 50M PhP is located in a municipality where it incurred a 180 kph of wind speed and 2.0 mm of rainfall for a particular day.

**Computation of payout:** The insured property will not receive any payout based on the amount of rainfall incurred since it is below 2.5 mm. But it will receive a payout based on the amount of wind speed since it is above the minimum wind speed requirement which is 60 kph. Thus, the payout is

$$\text{Payout} = \frac{50,000,000}{1,000} \times \left( \frac{180-60}{160} \times 1000 \right) = 37,500,000$$

Hence, the insured building will receive a payout amounting to 37.5M PhP.

**Illustration 2:** Suppose a public market with a value of 100M located in a certain municipality that incurred 120 kph of wind speed and 10 mm of rain fall on a particular day.

**Computation of payout:** The insured public market will receive a payout from the insurer based on both wind speed and rainfall since it is above the minimum requirement. Hence, the payout is

$$\begin{aligned} \text{Payout} &= \frac{100,000,000}{1,000} \times \left[ \left( \frac{10-2.5}{27.5} \right) \left( 1,000 - \frac{120-60}{160} \times 1,000 \right) + \frac{120-60}{160} \times 1,000 \right] \\ &= 27,272,727.27 \end{aligned}$$

Thus, the insured will receive a payout amounting to 27,272,727.27 PhP.



## ANNEX B

### Bases of the Parametric Insurance Model

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The Philippine Public Storm Warning System (PSWS) Signals<sup>xiii</sup> are as follows:

1. **PSWS Signal No. 1** – this indicates that the area affected should expect intermittent rains within at least 36 hours. Winds of 30 kph to 60 kph should be expected, although it is unlikely that they will cause significant damage. As a precaution, classes in all public and private pre-schools are automatically suspended.
2. **PSWS Signal No. 2** – this warning signal is raised in areas that will experience winds of 60 kph to 100 kph within at least 24 hours. Light to moderate damage is expected. Some trees may be uprooted and roofs blown away. People traveling by air and sea are cautioned, and disaster preparedness agencies should be alerting their respective communities. Classes from pre-school to high school are suspended.
3. **PSWS Signal No. 3** - people are advised to seek shelter inside strong buildings, evacuate low-lying areas, and stay away from coasts and riverbanks as moderate to heavy damage is expected. Winds of 100 kph to 185 kph are expected within at least 18 hours. The winds could topple trees and destroy crops and houses made of light materials. Widespread disruption of electrical power and communication services is also expected. Classes at all levels are automatically suspended.
4. **PSWS Signal No. 4** - indicates that a very intense typhoon with winds of more than 185 kph may be expected within at least 12 hours. The typhoon is potentially very destructive. Large trees are expected to be uprooted and residential and institutional buildings could be severely damaged. Travels and outdoor activities should be cancelled.
5. **PSWS Signal No. 5** - This recently added storm warning signal is raised when a super typhoon will affect an area. Very powerful winds of more than 220 kph may be expected in at least 12 hours. This typhoon is "extremely destructive or catastrophic" to the community as almost total damage to structures is expected. Most residential and institutional buildings may be severely damaged, and only a few crops and trees will be left standing. Evacuation to safer shelters should be completed early as it may already be too late if it hasn't begun. The disaster coordinating councils concerned and other disaster response organizations should be fully responding to emergencies by this time or completely ready to immediately respond to the calamity.

The Rainfall Advisory by PAGASA<sup>xiv</sup> is as follows:

1. **Yellow rainfall advisory** - Citizens should expect flooding in low-lying areas as 7.5-15 mm of rainfall (8 liters per square meter/hour) is expected within one hour and is likely to continue in the next two hours. There is also a possibility of a storm surge of .5-1 meter high. Everyone is advised to monitor the weather condition because the rainfall warning could be raised.
2. **Orange rainfall advisory** - Intense rains of 15-30 mm (15-30 liters per square meter/hour) are expected within one hour and flooding is considered a definite threat in communities under this alert. Rainfall is expected to continue in the next two hours and storm surges 1 meter to 3 meters high are expected.
3. **Red rainfall advisory** - This rainfall advisory is issued when downpours constitute an emergency. It is raised when the torrential rainfall is more than 30 mm within one hour or if it has continued for the past three hours and has risen to more than 65 mm (30 liters per square meter/hour). Storm surges over 3 meters high are expected and will most likely cause severe damage to coastal and marine infrastructure. Serious flooding is expected in low lying areas and evacuation to designated safe zones is recommended.

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## ANNEX C

### Insurance Model Data Requirements, Sources and Status

Data Requirement	Data Source/Responsible Unit		Status
<b>Properties' Loss and Damage Data</b> (minimum of 5 years)	<b>Local government units</b> (c/o Disaster Risk Reduction and Management Office or Municipal Planning and Development Office)	Primary assessment of losses, damages and needs for disasters that particularly hit their municipality	<ul style="list-style-type: none"> <li>- Loss and damage reports are only available for severe typhoons, these are also the primary assessments that have not been validated by OCD yet</li> <li>- For a 10-year period, LGUs were only able to provide a range of 1 to 4 loss and damage reports for typhoons</li> </ul>
	<b>Office of Civil Defense (OCD) Regional Offices</b> (with lead national government agencies concerned with the different sectors)	Assessment, validation and formulation of Post-Disaster Needs Assessment (PDNA)	<ul style="list-style-type: none"> <li>- Regional offices were inconsistent when it comes to the PDNA that they provide, some offices were able to provide PDNA that are LGU-specific, while others only provided aggregated summaries for either provinces or regions</li> <li>- Similar to the case of LGUs, regional offices only provided at most two PDNAs</li> </ul>
	<b>Post-Disaster Evaluation and Management Division,</b> OCD Rehabilitation and Recovery Management Service	Conduct of comprehensive damage and loss assessment	<ul style="list-style-type: none"> <li>- Reportedly started the collection of loss and damage assessment in 2009, after Typhoon Ondoy, but was not able to provide typhoon-specific PDNAs for the last ten years</li> <li>- Only provided PDNAs similar to those given by the OCD regional offices</li> </ul>
<b>Wind Speed, Rainfall Amount</b>	<b>Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)</b> (Data retrieved by UP NOAH Center from the World Meteorological Organization and US National Oceanic and Atmospheric Organization)		<ul style="list-style-type: none"> <li>- The data retrieved from UP NOAH Center could not be used for the model since wind speed and gustiness during extreme weather events are unavailable/not recorded, because PAGASA's manual stations are operated by persons in site. This was obtained by UP NOAH from the World Meteorological Organization and US National Oceanic and Atmospheric Organization, since this data is not directly handed out by PAGASA.</li> <li>- The wind speed of tropical cyclones are estimated by our meteorologists using the Dvorak Technique, an indirect measurement of tropical cyclone wind speed using satellite imagery. This data could not be provided by UP NOAH.</li> </ul>