

BARLO: **Bayani Alert and Response for** **Local Operations**

Predictive Impact Intelligence for Disaster Planning in the Philippines

Validated through on-ground interviews with DRRM officers



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Key Insight

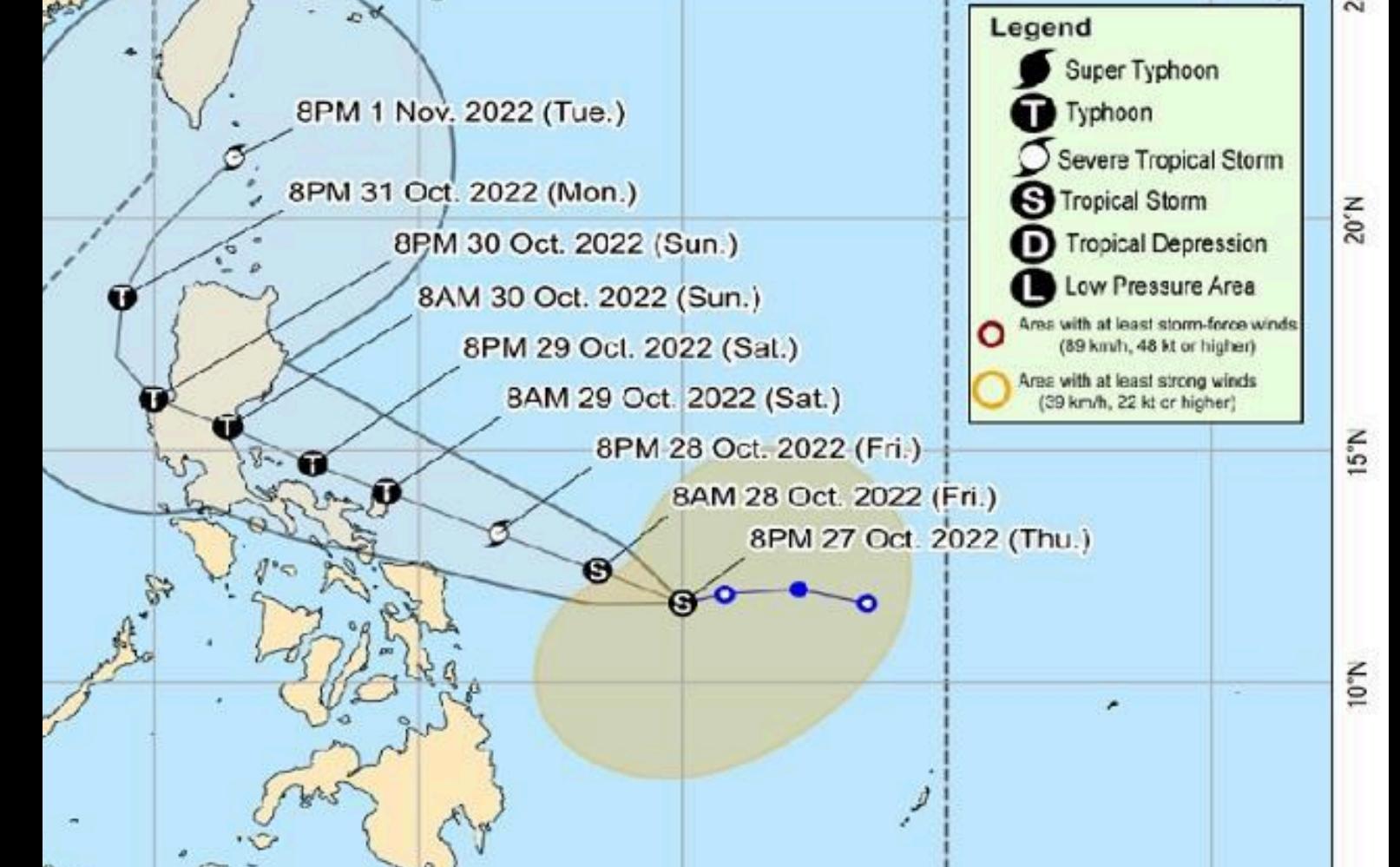


Local government already prepositions relief effectively despite common knowledge
(DSWD, 2025)



It's difficult to communicate the intensity of the impact
(Galloway, 2025)

The Problem



We know where the storm will go—
NOT how much it will destroy
Insights from interview

**Preparedness isn't the problem.
We can forecast the weather but not the impact.**

Forecasts tell us where storms will go but not how much they'll destroy.

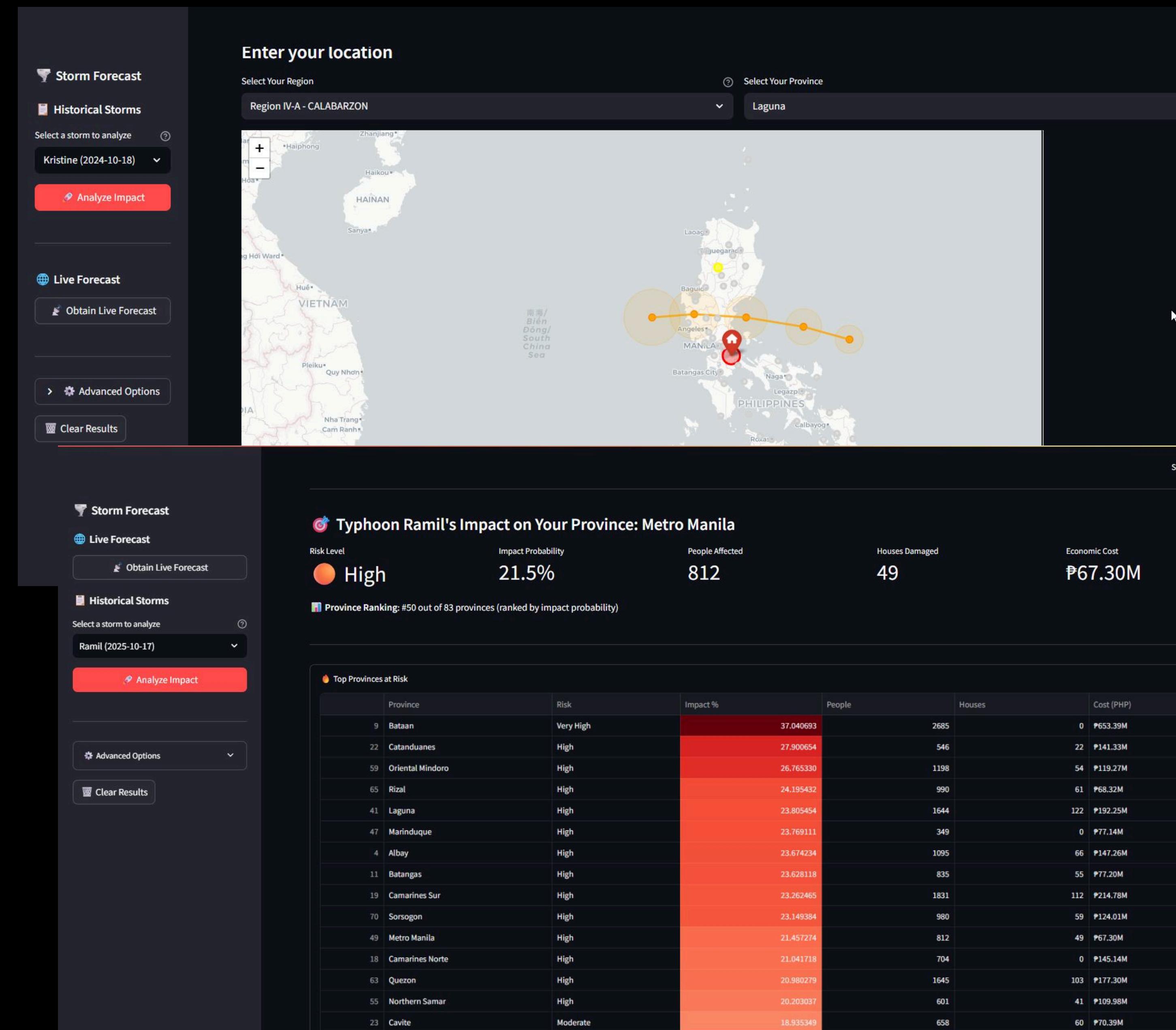
How might we enable disaster offices to forecast the impact of a typhoon so they can effectively prioritize on-the-ground monitoring, resources, and aid earlier in the process?

Introducing

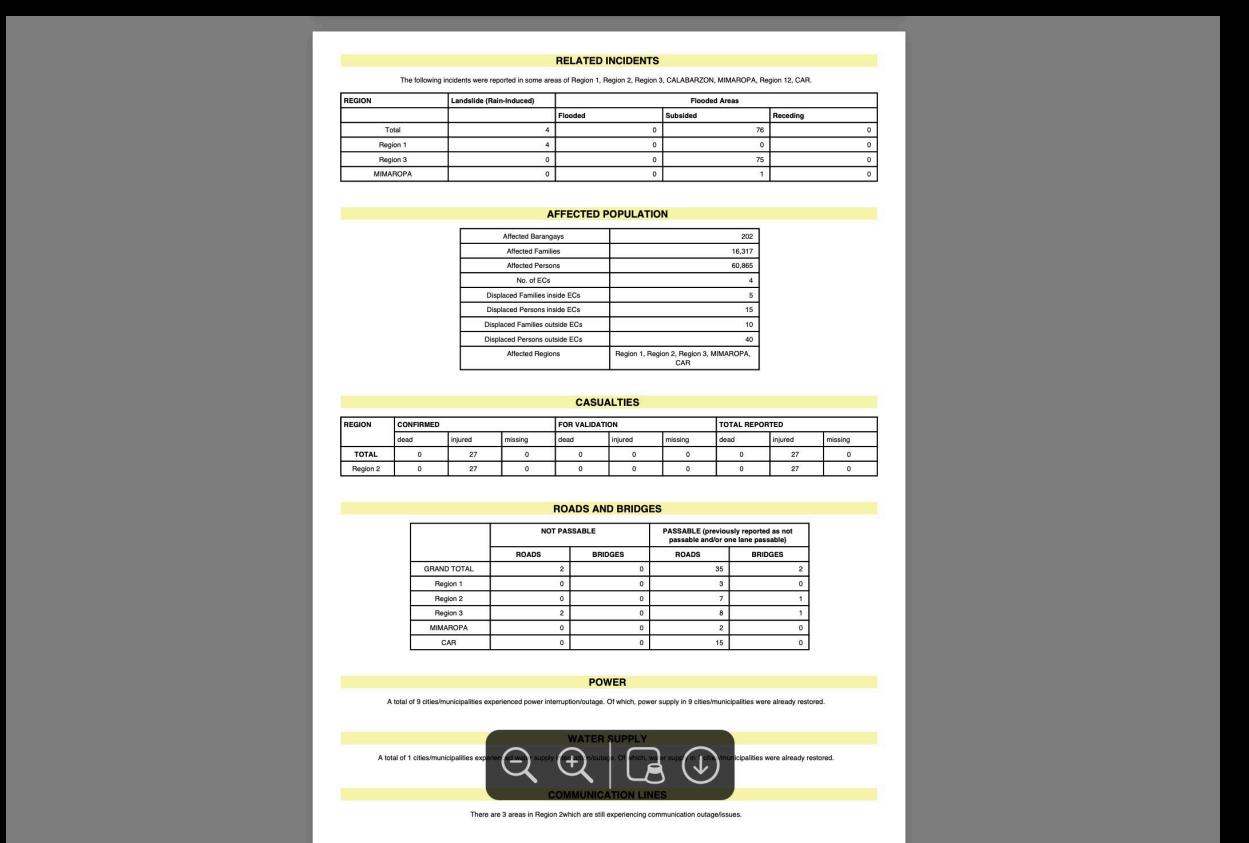
BARLO: Bayani Alert and Response for Local Operations

BARLO turns storm forecasts into impact forecasts.

Forecast Data → Php in economic impact



Data Ingestion & Sources



MinerU + Data Pipeline

1,000+ pdf files

50,000+ pages

DOOST-PAGASA

PSA



US Navy Meteorology

27,000 rows



Impact_Data > Impact_Data 2010-2020.csv
1 Year,Intl_Name,PH_Name,Province,Deaths,Affected,Houses destroyed,Houses damaged,Total Houses,Damage to Infrastructure (PhP),Damage to Agriculture + Fisheries (PhP),Category
2 2010,Conson,Basyang,Metro Manila,2,2802,62,0,62,1705000,0,Strong typhoon
3 2010,Conson,Basyang,Aurora,0,187,0,0,0,1930000,0,Strong typhoon
4 2010,Conson,Basyang,Bataan,10,68692,232,2695,2927,4950000,579332,Strong typhoon
5 2010,Conson,Basyang,Bulacan,3,189,0,0,0,23761000,0,Strong typhoon
6 2010,Conson,Basyang,Pampanga,0,221,0,0,0,0,0,Strong typhoon
7 2010,Conson,Basyang,Batangas,4,11605,102,1138,1240,1500000,0,Strong typhoon
8 2010,Conson,Basyang,Cavite,12,247537,2558,32735,35293,0,11822730,Strong typhoon
9 2010,Conson,Basyang,Laguna,10,87977,1516,8536,10052,3330000,47287410,Strong typhoon
10 2010,Conson,Basyang,Quezon,35,19284,133,1764,1897,4585000,145210000,Strong typhoon
11 2010,Conson,Basyang,Rizal,3,66678,2269,10917,13186,350000,26825503,Strong typhoon
12 2010,Conson,Basyang,Camarines Norte,18,52561,480,7459,7939,53200000,5632999,Strong typhoon
13 2010,Conson,Basyang,Camarines Sur,2,14845,1,119,120,0,150000,Strong typhoon
14 2010,Conson,Basyang,Catanduanes,0,12885,25,544,569,8400000,401906,Strong typhoon
15 2010,Conson,Basyang,Nueva Ecija,1,0,0,0,0,2400000,0,Strong typhoon
16 2010,Conson,Basyang,Zambales,0,0,0,1,0,1500000,Strong typhoon
17 2010,Megi,Juan,Metro Manila,1,877,0,0,0,0,0,Violent typhoon
18 2010,Megi,Juan,Ilocos Norte,0,7982,0,85,85,36920000,151046117,Violent typhoon
19 2010,Megi,Juan,Ilocos Sur,2,8771,12,225,237,2800000,165377858,Violent typhoon
20 2010,Megi,Juan,La Union,2,57543,545,5560,6105,9175000,268300770,Violent typhoon
21 2010,Megi,Juan,Pangasinan,10,482392,1095,8378,9473,9245000,2406270823,Violent typhoon
22 2010,Megi,Juan,Cagayan,1,158267,1048,14737,15785,33900000,496408990,Violent typhoon
23 2010,Megi,Juan,Isabela,2,710460,25186,72828,98014,205649000,2089965630,Violent typhoon
24 2010,Megi,Juan,Nueva Vizcaya,0,6975,1,36,37,5150000,123488000,Violent typhoon
25 2010,Megi,Juan,Quirino,0,17142,0,23,23,4000000,58083000,Violent typhoon
26 2010,Megi,Juan,Aurora,0,2394,0,9,9,100000,44977172,Violent typhoon
27 2010,Megi,Juan,Bataan,0,20560,2,20,22,3900000,109269882,Violent typhoon
28 2010,Megi,Juan,Bulacan,0,120,0,0,0,0,579592911,Violent typhoon
29 2010,Megi,Juan,Nueva Ecija,1,27247,4,22,26,17700000,1587045618,Violent typhoon
30 2010,Megi,Juan,Pampanga,0,100664,13,10,23,150000,113428605,Violent typhoon
31 2010,Megi,Juan,Tarlac,2,74621,13,117,130,6600000,645425917,Violent typhoon
32 2010,Megi,Juan,Zambales,5,12266,43,388,431,11568750,80854150,Violent typhoon
33 2010,Megi,Juan,Cavite,0,372,0,0,0,0,0,Violent typhoon
34 2010,Megi,Juan,Rizal,0,411,0,0,0,0,0,Violent typhoon
35 2010,Megi,Juan,Abra,0,8726,3,209,212,25425000,118312579,Violent typhoon
36 2010,Megi,Juan,Apayao,0,35461,58,1089,1147,19050000,309963089,Violent typhoon
37 2010,Megi,Juan,Benguet,2,30222,28,284,304,22080094,56457746,Violent typhoon
38 2010,Megi,Juan,Ifugao,2,5797,69,322,391,9364900,381895213,Violent typhoon
39 2010,Megi,Juan,Kalinga,1,214637,1778,12753,14531,13170000,442055166,Violent typhoon
40 2010,Megi,Juan,Mountain Province,0,25077,158,1079,1237,19750000,117570528,Violent typhoon
41 2011,Aere,Bebeng,Metro Manila,1,535,0,0,0,0,0,Tropical storm
42 2011,Aere,Bebeng,Bulacan,1,465,4,37,41,0,0,Tropical storm
43 2011,Aere,Bebeng,Catanduanes,2,0,0,0,0,1469000,14718889,Tropical storm
44 2011,Aere,Bebeng,Camarines Sur,16,196904,12,1080,1092,33080000,534194064,Tropical storm
45 2011,Aere,Bebeng,Albay,6,85077,0,0,0,280897990,310771168,Tropical storm
46 2011,Aere,Bebeng,Cagayan,1,20701,0,550,5500,15450000,162000000,Tropical storm

Next Steps: Where BARLO Goes from Here

The need for a predictive tool has been validated — next is proving its value in real operations.

Localized Deployment: Batangas City CDRRMO

Expand and integrate BARLO into pre-disaster planning to identify high-risk areas (property composition, geography, etc) and guide

Faster response, localized foresight, data-backed decision-making.

Framework Expansion

Enhance the model by integrating more datasets — infrastructure, agriculture, fisheries, everything gov't stakeholders need to broaden predictive

Multi-sector insight for coordinated disaster planning.

National Integration

Connect BARLO's framework with NDRRMC and OCD pipelines to unify predictive data across agencies.

A national standard for early impact forecasting and resource allocation.

BARLO

From Forecasts to Foresight.

References

Department of Social Welfare and Development. (2025, October 16). DSWD-DROMIC Report #15 on the effects of Typhoon Paolo as of 16 October 2025, 6 PM. Disaster Response Operations Monitoring and Information Center. <https://dromic.dswd.gov.ph/wp-content/uploads/2025/10/DSWD-DROMIC-Report-15-on-the-Effects-of-Typhoon-Paolo-as-of-16-October-2025-6PM.pdf>.

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Data Sets

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Modelling Approach

A hurdle-type framework filters non-impacted provinces first, then estimates damage magnitude using XGBoost models.

The result: calibrated, low-error predictions even with limited labeled data.

Stage 1 — Impact Occurrence (Classifier)

Goal: Predict if this province will experience any significant impact

Model: XGBClassifier (binary:logistic)

Output: "At-risk" or "No impact"

Only positive cases flow into Stage 2

Stage 2 — Impact Magnitude (Regressor)

Goal: Estimate the number of people affected or houses damaged

Model: XGBRegressor (reg:squarederror)

Output: Quantified loss per province
(continuous values)

Ending Output:
Predicted Impact
Counts

Feature Engineering

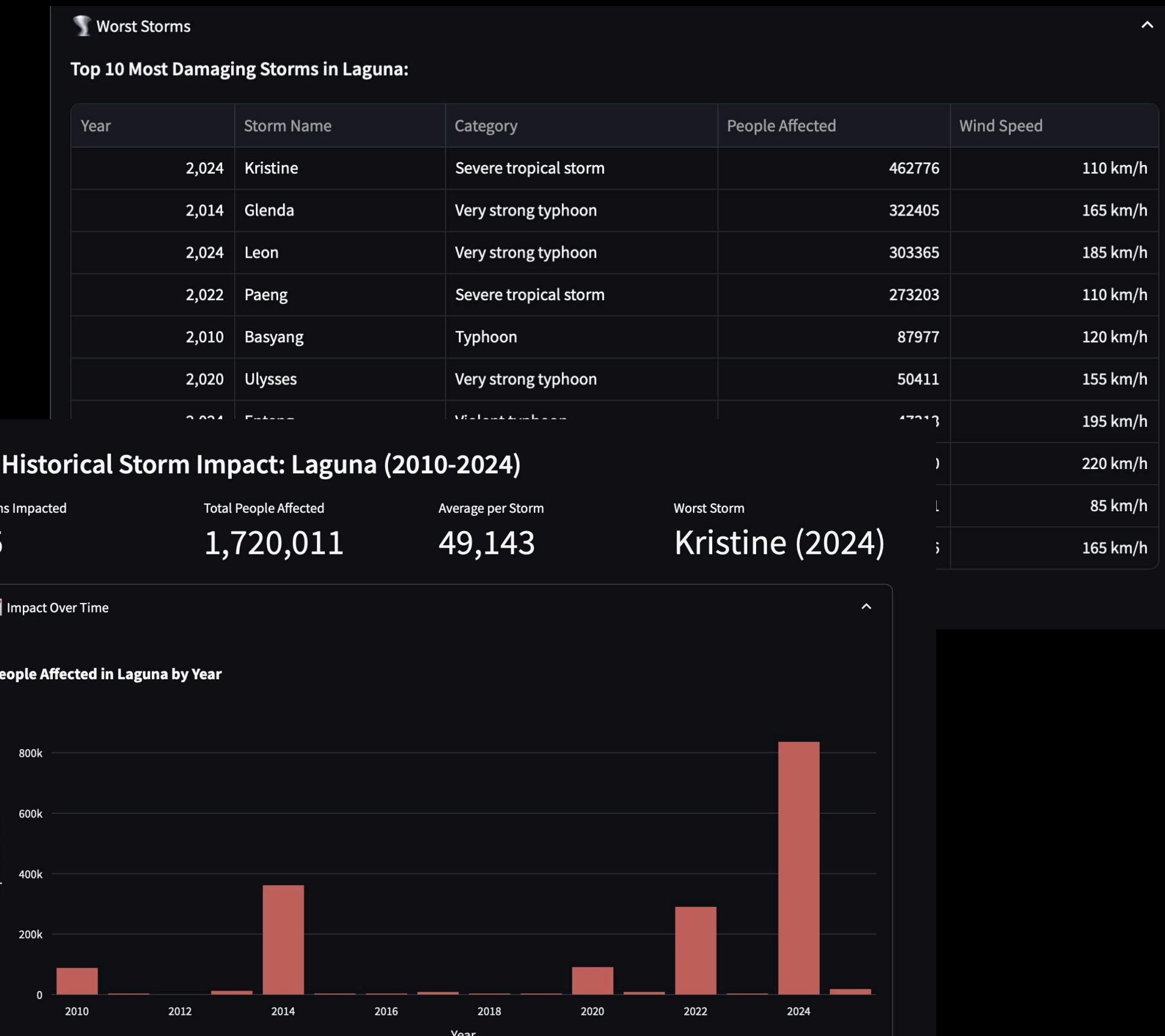
BARLO translates raw storm and weather data into 30+ engineered features:

Spatial & Temporal Dynamics

- Distance to storm track
- Hours under wind radius thresholds (50–500 km)
- Approach & departure speed
- Bearing and directionality

Exposure & Vulnerability

- Population density
- Urbanization proxy
- Precipitation totals and rolling wind values





The Value of Predictive Systems

Manual Damage Tracking

After a typhoon, LGUs rely on barangay disaster offices to report damage to homes, roads, and crops.

These reports take days to compile — often incomplete or inconsistent.

Fragmented Verification Process

Data passes through layers: barangay → city/municipal DRRMO → provincial → national agencies (DSWD, DPWH, DA). Each step adds validation time before funds or aid can move. (Department of Social Welfare and Development, 2025)

Slow Damage Confirmation

Before a city can declare a state of calamity, it must prove significant damage to property.

If reports are missing or delayed, mobilization stalls even when communities are already struggling. (Galloway et al., 2025)

Human Cost

Families stay in evacuation centers for weeks.
Supplies run out.
LGUs are forced into emergency purchases to keep people fed and safe.

Predictive systems can help government see impact before it happens