

S&T Roadmap for Disaster Risk Reduction and Climate Change Adaptation (DRR-CCA)

CY 2021-2028



Disaster Risk Reduction (Tsunami Hazard)

Vision

 Collated readily- accessible maps and models for most vulnerable and high- risk areas capable of early detection and warning for tsunamis

OVERALL STRATEGIES

a. Human Resource

- Training human resource in the analysis of multi-natural hazard mapping and modeling for seismic and hydro-geologic hazards.
- Increase and availability of experts.
- Capacity Building and Training for stakeholders and beneficiaries.
- Partnership with LGUs for community-based warnings
- Trained human resource on integrating tsunami hazard information in DRR plans at the local levels

b. R&D Technologies

- Maintenance and updating of data platforms.
- Establishment of accurate and precise early warning systems for multi-natural hazards.
- Updating Vulnerability and Risk Maps.
- Operationalization of outputs from the stakeholders by the mandated agencies.

c. Facilities and Services

 Establishment of GIS and remote sensing processing laboratories for big data analytics.

d. S&T Policies

 Dialogue and coordination with LGUs and policy makers for concrete applications.

NAST Foresight

- Remote Sensing and GIS-aided Precision Tools Online Real-time Monitoring and Information
- Systems/Networks 3D Mapping and Landform Modeling Tools
- Thematic Areas
 - Multi- Hazard Assessment Tools and Systems Vulnerability Assessment, Risk and Warnina
 - **Communication Systems**
 - Localization of observation and Forecasting **Tools & Monitoring Networks**

50M

50M

Possible Solutions

• Tsunami Vulnerability Maps for all coastline communities

Community-based Risk communication, capacity building and preparedness

Risk Assessment Maps for Tsunami-prone Areas in PAR

15M · Optimized and Freely-accessible Early Warning and Alarm Systems for **Coastal Communities Nationwide**

15M

- Community- based early warning plan
- Capacity building/effective risk communication for coastal communities

20M

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Deployment of working, real-time accurate and optimized tsunami early detection, warning and information systems

2021

Integrated operational real-time monitoring networks for tsunamis

50M

- Other alternative Early Warning Systems (EWS) for tsunami (low-cost, locally
- fabricated and developed detection systems)

10M

• Further analysis and generation of maps and models for tsunami-prone areas in the Philippines

15M

Tsunami mapping and modeling based on historical, geomorphological and geological evidence of past earthquakes

2022 Turned over cleared EWS to PHIVOLCS

2023

• Further analysis and generation of maps and models for tsunami-prone areas in the Philippines

2024

• Updated maps/models and assessments/analysis

Milestones

Areas with RA studies for tsunami Effective Risk Communication. Capacity building

and preparedness

for Communities

Not yet Available

- 2027
 - Updated VA maps for all coastlines

2028

- Adopted monitoring networks by PHIVOLCS
- Capacitated LGUs with trained communities
- Working and accurate tsunami early detection and warning system
 - Systems monitored by LGUs and PHIVOLCS

2025

Overall Outcomes

a.Human Resource

- Trained human resource on tsunami processing and analysis.
- b. R&D Technologies
- High-resolution tsunami maps and models
- Low-cost and Locally-developed instrumentation for early warning
- c. Facilities/Services
- Laboratories for data processing tsunami maps and models.
- · Establishment of platform for information and dissemination, communication plan and other tools for communication d. S&T Policies
- Policy recommendation to LGUs in tsunami-prone areas and PHIVOLCS as the mandated agency.

- - 2026

Disaster Risk Reduction (Earthquake Hazard)

2028

Capacity building and

Identification and Assessment

of secondary hazards resulting

from earthquakes

Effective Risk Communication.

preparedness for Communities

Vision

· Collated readily- accessible maps and models for most vulnerable and high-risk areas to earthquakes

OVERALL STRATEGIES

a. Human Resource

- Training human resource in the analysis of multi-natural hazard mapping and modeling for seismic and hydro-geologic hazards.
- Increase and availability of experts.
- Capacity Building and Training for stakeholders and beneficiaries.
- Partnership with LGUs for community-based warnings
- Trained human resource on integrating earthquake hazard information in DRR plans at the local levels

b. R&D Technologies

- Maintenance and updating of data platforms.
- Establishment of accurate and precise early warning systems for multi-natural hazards.
- Updating Vulnerability and Risk Maps.
- Operationalization of outputs from the stakeholders by the mandated agencies.
- c. Facilities and Services
- Establishment of GIS and remote sensing processing laboratories for big data analytics.

d. S&T Policies

• Dialogue and coordination with LGUs and policy makers for concrete applications.

NAST Foresight

- Remote Sensing and GIS-aided Precision Tools Online Real-time Monitoring and Information
- Systems/Networks • 3D Mapping and Landform Modeling Tools

Tools & Monitoring Networks

- Thematic Areas
- Multi- Hazard Assessment Tools and Systems Vulnerability Assessment, Risk and Warnina Communication Systems

Localization of observation and Forecasting

30M

Community-based Risk communication, capacity building and preparedness

Post- earthquake fire assessment (ex. fire as a secondary hazard resulting from earthquakes) Old edifices/ culturally important infrastructures damaged by earthquakes (vulnerability and propose immediate interventions)

15M

• Risk Assessment Maps for Earthquake-prone Areas

2023

Updated nationwide Earthquake Hazard Maps

Possible Solutions

20M

15M

• Earthquake Vulnerability Maps for the Philippines

2022

2021

100M

- Updating of Exposure Data Maps all over the Philippines
- Translation of earthquake- related vector data from the 1970s to digital files
- Additional reference for earthquakes historical data digital files

15M

 Nationwide Earthquake hazard Mapping and Modeling thru Alternative Methods

10M

 Updating of Earthquake Projections through new and faster alternative techniques (including onshore and offshore mapping in PAR)

10M

Updating of nationwide Earthquake Hazard Map (Onshore and preidentified Offshore areas)

2024 Updated VA maps

• Faster Nationwide Earthquake

Hazard Mapping

Updated nationwide Earthquake Projections

Milestones

- Updated Exposure maps for the Philippines •
- Modeling earthquake Hazards from new and historical data

Overall Outcomes

a.Human Resource

Trained human resource on tsunami processing and analysis.

2027

- b. R&D Technologies
- High-resolution tsunami maps and models
- Low-cost and Locally-developed instrumentation for early warning
- c. Facilities/Services
- Laboratories for data processing tsunami maps and models.
- Establishment of platform for information and dissemination, communication plan and other tools for communication

d. S&T Policies

 Policy recommendation to LGUs in tsunami-prone areas and PHIVOLCS as the mandated agency.

2026 2025

Updated RA maps

Disaster Risk Reduction (Volcanic Hazard)

Online Real-time Monitoring and Information

Multi- Hazard Assessment Tools and Systems

Vulnerability Assessment, Risk and Warning

Localization of observation and Forecasting

• 3D Mapping and Landform Modeling Tools

Vision

 Collated readily- accessible maps and models for most vulnerable and high- risk areas capable of early detection and warning for volcanic hazards

OVERALL STRATEGIES

a. Human Resource

- Training human resource in the analysis of multi-natural hazard mapping and modeling for seismic and hydro-geologic hazards.
- Increase and availability of experts.
- Capacity Building and Training for stakeholders and beneficiaries.
- Partnership with LGUs for community-based warnings
- Trained human resource on integrating volcanic hazard information in DRR plans at the local levels

b. R&D Technologies

- Maintenance and updating of data platforms.
- Establishment of accurate and precise early warning systems for multi-natural hazards.
- Updating Vulnerability and Risk Maps.
- Operationalization of outputs from the stakeholders by the mandated agencies.
- c. Facilities and Services
- Establishment of GIS and remote sensing processing laboratories for big data analytics.

d. S&T Policies

• Dialogue and coordination with LGUs and policy makers for concrete applications.

NAST Foresight Remote Sensing and GIS-aided Precision Tools

Systems/Networks

Thematic Areas

Possible Solutions

Community-based Risk communication, capacity building and preparedness

2024

Alternative locally-

seismic activity

fabricated instruments

for measuring data and

15M

Risk Assessment Maps for Volcanic Hazards-prone Areas

2025

15M Volcanic Hazards Vulnerability Maps for the Philippines

30M

Communication Systems

Tools & Monitoring Networks

Bathymetric Mapping of Sub-lacustrine Features in Volcanic Lakes

2021

20M

- 20M
- Translation of active volcano vector data from the 1970s to digital files
 - 30M
 - Low-cost instrumentation for geophysico-chemical monitoring and/or sampling/data collection volcanic gases and the volcanic crater

10M

 Updating additional reference for Volcanic E ruption historical data

Updated nationwide Volcanic Eruption data

2022

2023

Milestones

- 2028
- 2027 Effective Risk Communication. Capacity building and Updated RA maps preparedness for Updated VA Maps Communities
- Bathymetric data for active volcanoes

2026

Updated maps and projections incorporating new and historical data

Overall Outcomes

a.Human Resource

- Trained human resource on tsunami processing and analysis.
- b. R&D Technologies
- High-resolution tsunami maps and models
- Low-cost and Locally-developed instrumentation for early warning
- c. Facilities/Services
- Laboratories for data processing tsunami maps and models.
- · Establishment of platform for information and dissemination, communication plan and other tools for communication

d. S&T Policies

 Policy recommendation to LGUs in tsunami-prone areas and PHIVOLCS as the mandated agency.

Disaster Risk Reduction (Landslide Hazard)

Vision

 Collated readily- accessible maps and models for most vulnerable and high- risk areas capable of early detection and warning for landslides

OVERALL STRATEGIES

a. Human Resource

- Training human resource in the analysis of multi-natural hazard mapping and modeling for seismic and hydro-geologic hazards.
- Increase and availability of experts.
- Capacity Building and Training for stakeholders and beneficiaries.
- Partnership with LGUs for community-based warnings
- Trained human resource on integrating landslide hazard information in DRR plans at the local levels

b. R&D Technologies

- Maintenance and updating of data platforms.
- Establishment of accurate and precise early warning systems for multi-natural hazards.
- Updating Vulnerability and Risk Maps.
- Operationalization of outputs from the stakeholders by the mandated agencies.
- c. Facilities and Services
- Establishment of GIS and remote sensing processing laboratories for big data analytics.

d. S&T Policies

• Dialogue and coordination with LGUs and policy makers for concrete applications.

NAST Foresight

- Remote Sensing and GIS-aided Precision Tools Online Real-time Monitoring and Information Systems/Networks
- 3D Mapping and Landform Modeling Tools
- Thematic Areas
 - Multi- Hazard Assessment Tools and Systems Vulnerability Assessment, Risk and Warning
 - Communication Systems
 - Localization of observation and Forecasting Tools & Monitoring Networks

Possible Solutions

- 35M
- Risk Assessment Maps for Landslide-prone Areas
- Community-based Risk communication, capacity building and preparedness

50M

• Lahar/ Landslide Models based on Climate Maps and Models

Nationwide Operational Landslide Monitoring and Warning System

2025

 Preliminary Vulnerability studies (sample sites) 30M Radar-Based Flashfloods and Landslides Forecasting • Satellite Based Flashfloods and Landslides Forecasting

2022

2021

30M

· Landslide in mining areas particularly slope failure in open pit O Effects of hydrothermal alteration to weathering and erosion O Applicability of open pit design for certain geological conditions and rainfall threshold data

25M

50M

- Updated landslide inventory of earthquake-induced and rain-induced landslide forecasting
- Landslide thresholds and models for areas with mining activities
- Landslide thresholds based on different Lithological Types

10M

earthquake-induced and raininduced landslide forecasting

10M

• Updating of landslide maps and models

2027 2026 • Updated VA Maps

Updated RA Maps Effective Risk Communication. Capacity building and preparedness 2028 for Communities

Not yet Available

National Monitoring and Warning Systems updated by mandated agencies

- Landslide Forecasting using Alternative Methods
- 2023 Landslide models for mining areas and introduction of interventions
 - Nationwide rain-induced and earthquake-induced landslide thresholds database

2024

- Landslide models in different typological substrates/ types
- Operational monitoring networks for landslide forecasting
- Landslide models incorporated in the existing activities of DENR- MGB

Milestones

- **Overall Outcomes**
- a.Human Resource
- Trained human resource on tsunami processing and analysis.
- b. R&D Technologies
- High-resolution tsunami maps and models
- Low-cost and Locally-developed instrumentation for early warning

c. Facilities/Services

- Laboratories for data processing tsunami maps and models.
- Establishment of platform for information and dissemination, communication plan and other tools for communication

d. S&T Policies

 Policy recommendation to LGUs in tsunami-prone areas and PHIVOLCS as the mandated agency.

Updated landslide inventory of

Disaster Risk Reduction (Tropical Cyclone Hazard)

Not yet Available

Updated VA and

Effective Risk

Communication.

Capacity building

and preparedness

for Communities

RA Maps

2028

Modeling for rapid intensification and

intensity forecasting for PAR

Vision

 Collated readily- accessible maps and models for most vulnerable and high- risk areas capable of early detection and warning for tropical cyclones

OVERALL STRATEGIES

a. Human Resource

- Training human resource in the analysis of multi-natural hazard mapping and modeling for seismic and hydro-geologic hazards.
- Increase and availability of experts.
- Capacity Building and Training for stakeholders and beneficiaries.
- Partnership with LGUs for community-based warnings
- Trained human resource on integrating tropical cyclone hazard information in DRR plans at the local levels
- b. R&D Technologies
- Maintenance and updating of data platforms.
- Establishment of accurate and precise early warning systems for multi-natural hazards.
- Updating Vulnerability and Risk Maps.
- Operationalization of outputs from the stakeholders by the mandated agencies.
- c. Facilities and Services
- Establishment of GIS and remote sensing processing laboratories for big data analytics.

d. S&T Policies

• Dialogue and coordination with LGUs and policy makers for concrete applications.

NAST Foresight

- Remote Sensing and GIS-aided Precision Tools Online Real-time Monitoring and Information
- Systems/Networks • 3D Mapping and Landform Modeling Tools
- Thematic Areas
 - Multi- Hazard Assessment Tools and Systems Vulnerability Assessment, Risk and Warnina
 - Communication Systems
 - Localization of observation and Forecasting Tools & Monitoring Networks

Possible Solutions

50M

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2023

- Vulnerability and Risk Assessment Maps for Tropical Cyclone-prone Areas Community-based Risk communication, capacity building and preparedness
- 50M Application of predictive analytics on magnitude tropical cyclone rapid intensification Nationwide Intensity Forecast Guidance of Tropical Thunderstorms and Tropical Cyclones

15M

Typhoon Structure/Wind Radii/Intensity Change Modelling and forecasting

20M

- Weather Forecast Visualization
- Enhancement of the Objective Forecast Guidance and Operational Support Systems for Tropical Cyclones

2022

and Risk Assessment

Cebu Citv

2021

20M

- Storm surge forecasting using wind and wave current for the whole **Philippines**
- Automation of storm surge models

60M

- Detection/Mapping/Monitoring for Micro-weather Forecasting
- Bow Echo Detection for Tornado Warning

20M

and Forecasting for Storm Surge, Lightning and Thunderstorms and Severe Wind

30M

Updating of typhoon • maps and models

2024

Impact-based Risk Assessment for the rest

of the country in municipality/city level

Updated Visualization of TCs in PAR

2026

- Working and accurate tsunami early detection and warning system
- Systems monitored by LGUs and PHIVOLCS

2025

Overall Outcomes

a.Human Resource

Trained human resource on tsunami processing and analysis.

2027

Intensity level short term forecast for TCs in PAR

- b. R&D Technologies
- High-resolution tsunami maps and models
- Low-cost and Locally-developed instrumentation for early warning
- c. Facilities/Services
- Laboratories for data processing tsunami maps and models.
- Establishment of platform for information and dissemination, communication plan and other tools for communication

d. S&T Policies

 Policy recommendation to LGUs in tsunami-prone areas and PHIVOLCS as the mandated agency.

Milestones

other parameters in open sea setting

Database for Storm Surge, Lightning and Thunderstorms and Severe Wind Models

Severe Wind Maps and Models (nationwide), Vulnerability Curves for Severe Wind

Exposure of Different Building Types, Exposure Database and Risk Assessment for

Storm surge forecasting using wind, wave current and



- Cloud/Thunderstorm High-resolution Near real-time
- Ship Route Gale warning Visualization

Improvement of the Prediction

Disaster Risk Reduction (Floods and Heavy Rains Hazard)

 Collated readily- accessible maps and models for most vulnerable and high-risk areas capable of early detection and warning for floods and heavy rains

Vision

- Nationwide Vulnerability and Risk Assessment Studies for Urban and River Flooding-prone Areas
- Community-based Risk communication, capacity building and preparedness

20M

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Possible Solutions

- Flood Vulnerability and Risk Assessments for critical Coastal Areas
 - Land subsidence
 - Urban/river flooding

25M

Communication Systems

Tools & Monitoring Networks

NAST Foresight

Thematic Areas

Systems/Networks

Remote Sensing and GIS-aided Precision Tools

· Online Real-time Monitoring and Information

Vulnerability Assessment, Risk and Warning

Localization of observation and Forecasting

OVERALL STRATEGIES

• Training human resource in the

and hydro-geologic hazards.

analysis of multi-natural hazard

mapping and modeling for seismic

Increase and availability of experts.

Capacity Building and Training for

integrating floods and heavy rains

hazard information in DRR plans at

Maintenance and updating of data

precise early warning systems for

Operationalization of outputs from

the stakeholders by the mandated

Establishment of GIS and remote

Dialogue and coordination with

LGUs and policy makers for

concrete applications.

Establishment of accurate and

• Updating Vulnerability and Risk

multi-natural hazards.

c. Facilities and Services

big data analytics.

d. S&T Policies

stakeholders and beneficiaries.

Partnership with LGUs for

community-based warnings

Trained human resource on

the local levels

platforms.

Maps.

agencies.

b. R&D Technologies

a. Human Resource

- Strengthening Nowcasting of Thunderstorm and Heavy Rainfall (Radar, QPE, QPF, MCS)
- Application of Artificial Intelligence (AI) in Weather Forecasting

25M

- Advanced Space Technology for Real-Time Flood Monitoring; Internet of Things (IoT) Approach and Cloud Computing in Flood Forecasting
- Sedimentological and geomorphological approach in flood hazard models: Identifying recurrence pattern using direct evidence

2021

- 30M Flood Forecasting & Early Warning using Advance Technology (Radar, Satellite, High Resolution Modelling and others)
- Convective Scale Modelling and Ensembled Forecasting

30M

- Flood Forecasting for Vulnerable Areas
- o Land subsidence •
- o Urban/river flooding

40M

- and/or systems sensing processing laboratories for • Street level/ barangay level/
 - monitoring and early warning system for all rivers nationwide Municipality/ City Level Early
 - Warning Forecasting for Floods
 - Updating of flood maps and • models

Repository of Location-based land

subsidence and river flood reports

Automated collection of data from storm drains and canals

Recurrence patterns and introduction of interventions

2026

- Floods and heavy rains Forecasting using Alternative Methods
 - **Overall Outcomes**
 - a.Human Resource
 - Trained human resource on tsunami processing and analysis.
 - b. R&D Technologies
 - High-resolution tsunami maps and models
 - Low-cost and Locally-developed instrumentation for early warning
 - c. Facilities/Services
 - Laboratories for data processing tsunami maps and models.
 - Establishment of platform for information and dissemination, communication plan and other tools for communication

d. S&T Policies

 Policy recommendation to LGUs in tsunami-prone areas and PHIVOLCS as the mandated agency.

2022

community-based EWS

- Community or Barangay Level Near-real time

- Intelligent storm drain/canal sensors
- community level near-real time river

20M

• 3D Mapping and Landform Modeling Tools 50M Multi- Hazard Assessment Tools and Systems

2027

Vulnerable and High-Risk Areas for Floods and **Heavy Rains** Communication. Capacity building and preparedness for Communities

Updated maps and models for

highly

Not yet Available

Ongoing

Urban flood maps and models with means of validation/ verification Vulnerability and Risk Maps for Land subsidence and

2028

- urban/river flooding

2025

Flood monitoring systems (river inputs and heavy rains) and

Milestones

- 2024
- 2023

Legend (Text Font):

Climate Change Adaptation (Climate Change- related Hazards)

Not yet Available

Vision

 Collated readily- accessible maps and models for most vulnerable and high- risk areas capable of early detection and warning for climate change- related hazards

• 3D Mapping and Landform Modeling Tools 100M Space Weather Monitoring System Common Monitoring and Evaluation of Climate Actions in the Philippines Nationwide Vulnerability and Risk Assessment Studies for Extreme Weather Phenomena, Temperature Extremes or Sea Level • Communication Systems Rise/Flooding Community-based Risk communication, capacity building and preparedness 50M User Interface platforms (UIPs) for Communicating Weather, Flood, and Climate Risks Socio-Economic Valuation of Meteorological Products and Services Loss and Damage related to Climate Change events Areas with RA Climate Change Scenarios : Top Most Vulnerable Provinces in the Philippines studies for 15M tsunami Communication. Capacity building and preparedness for Communities 2028 2027 2026 Climate Change Data for the most vulnerable 2025 in PAR Updated Database and Information Systems for Public Use 2024 Thermal and environmental-related land-use scenarios Recurrence patterns and introduction of interventions 2023 Sectoral Impacts of Climate Change-related effects **Overall Outcomes** Field validated thermal and environmental-related 2022 a.Human Resource land-use scenarios Developed low-cost and local instruments/sensors Trained human resource on tsunami processing and analysis. for extreme phenomena b. R&D Technologies • High-resolution tsunami maps and models Field validated values for Coastal Flooding, Land Surface Low-cost and Locally-developed instrumentation for early warning Temperatures, Urban Heat Island and Micro-climate projections

- c. Facilities/Services
- Laboratories for data processing tsunami maps and models.
- Establishment of platform for information and dissemination, communication plan and other tools for communication

d. S&T Policies

 Policy recommendation to LGUs in tsunami-prone areas and PHIVOLCS as the mandated agency.

NAST Foresight

- Remote Sensing and GIS-aided Precision Tools Online Real-time Monitoring and Information
- Systems/Networks
- Thematic Areas
 - Multi- Hazard Assessment Tools and Systems Vulnerability Assessment, Risk and Warning
 - Localization of observation and Forecasting

Possible Solutions

mapping and modeling for seismic and hydro-geologic hazards. Tools & Monitoring Networks Increase and availability of experts.

• Capacity Building and Training for stakeholders and beneficiaries.

• Training human resource in the

analysis of multi-natural hazard

 Partnership with LGUs for community-based warnings

OVERALL STRATEGIES

a. Human Resource

 Trained human resource on integrating climate change-related hazard information in DRR plans at the local levels

b. R&D Technologies

- Maintenance and updating of data platforms.
- Establishment of accurate and precise early warning systems for multi-natural hazards.
- Updating Vulnerability and Risk Maps.
- Operationalization of outputs from the stakeholders by the mandated agencies.

c. Facilities and Services

 Establishment of GIS and remote sensing processing laboratories for big data analytics.

d. S&T Policies

• Dialogue and coordination with LGUs and policy makers for concrete applications.

• Multi-scale monitoring and prediction of climate extremes

100M

- Subsidence hazards Engineering geology and geotechnical applications and monitoring system for • karst subsidence
- Green spaces in major urban centers
- Interventions to reduce 75% greenhouse gases emissions (as part of the National Commitment) tion

50M

- Sectoral impacts and risk assessment of possible changes in rainfall, temperature, wind, humidity, and other meteorological elements-Convective Scale Modelling and Ensembled Forecasting
- Ocean Forecast System for Marine Activities
- Groundwater Resource Groundwater management subsector

50M

- Impact-based Forecasting for Flooding, Landslides, Severe Wind and Storm Surge
- Mapping, modeling/projections and instrumentation for extreme phenomena

20M

Means of Verification and validation of the projections for coastal flooding projections

30M

- Coastal flooding projections from sea-level rise (in meters) Land Surface Temperatures, Urban Heat
 - Island and Micro-climate ensemble model and projections

2021

Database/repository of Coastal Flooding, Land Surface Temperatures, Urban Heat Island, Micro-climate ensemble models and projections with the Philippine Area of Responsibility (PAR) as the domain

