Funding Proposal

SAP010: Multi-Hazard Impact-Based Forecasting and Early Warning System for the Philippines

Philippines | Landbank of the Philippines (Landbank)| Decision B.24/09

4 December 2019

GREEN CLIMATE FUND

Simplified Approval Process
Funding Proposal

Project/Programme title:	**Multi-Hazard Impact-Based Forecasting and Early Warning System (MH-IBF-EWS) for the Philippines**
Country:	PHILIPPINES
National Designated Authority(ies):	Climate Change Commission
Accredited Entity:	Land Bank of the Philippines (LANDBANK)
Executing Entity	Department of Science and Technology - Philippine Atmospheric Geophysical and Astronomical Services Administration (DOST-PAGASA)
Co-Executing Entities:	Department of Environment and Natural Resources – Mines and Geosciences Bureau (DENR-MGB), Department of the Interior and Local Government (DILG), Office of Civil Defense (OCD), Tuguegarao City Local Government Unit (LGU), Legazpi City LGU, Palo, Leyte LGU, New Bataan, Davao de Oro LGU, and World Food Programme (WFP)
Date of first submission:	March 5, 2019 (concept note), June 17, 2019 (funding proposal)
Date of current submission/ version number	2019/09/19 version 7
If available, indicate GCF code:	FP Philippines Landbank 21660 SAP [iPMS#21660]

GREEN CLIMATE FUND

Contents

Note to accredited entities on the use of the SAP funding proposal template

- The Simplified Approval Process Pilot Scheme (SAP) supports projects and programmes with a GCF contribution of up to USD 10 million with minimal to no environmental and social risks. Projects and programmes are eligible for SAP if they are ready for scaling up and have the potential for transformation, promoting a paradigm shift to low-emission and climate-resilient development.
- This template is for the SAP funding proposals and is different from the funding proposal template under the standard project and programme cycle. Distinctive features of the SAP funding proposal template are:
  - *Simpler documents*: key documents have been simplified, and presented in a single, up-front list;
  - *Fewer pages*: A shorter form with significantly fewer pages. The total length of funding proposals should **not exceed 20 pages**;
  - *Easier form-filling*: fewer questions and clearer guidance allows more concise and succinct responses for each sub-section, avoiding duplication of information.
- Accredited entities can either directly incorporate information into this proposal, or provide summary information in the proposal with cross-reference to other funding proposal documents such as project appraisal document, pre-feasibility studies, term sheet, legal due diligence report, etc.
- Submitted SAP Pilot Scheme funding proposals will be disclosed simultaneously with submission to the Board, subject to the redaction of any information which may not be disclosed pursuant to the GCF Information Disclosure Policy.

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Please use the following name convention for the file name:

“SAP-FP-[Accredited Entity Short Name]-[yymmdd]”

A. PROJECT/PROGRAMME SUMMARY

A.1. Has this FP been submitted as a SAP CN before?			Yes ☒ No ☐
A.2. Is the Environmental and Social Safeguards Category C or I-3?			Yes ☒ No ☐
A.3. Project or programme	*Indicate whether this FP refers to a combination of several projects (programme) or one project.* ☒ Project ☐ Programme	**A.4. Public or private sector**	☒ Public sector ☐ Private sector
A.5. Result area(s)	*Indicate the result areas for the project/programme.* Mitigation: Reduced emissions from: ☐ Energy access and power generation ☐ Low emission transport ☐ Buildings, cities and industries and appliances ☐ Forestry and land use Adaptation: Increased resilience of: ☒ Most vulnerable people and communities, including women and girls ☐ Health and well-being, and food and water security ☐ Infrastructure and built environment ☐ Ecosystem and ecosystem services		
A.6. Total investment (GCF + co-finance)	20,191,349.96 (USD)	**A.7. Total GCF funding requested**	9,999,042.27 (USD)
A.8. Type of financial instrument requested for the GCF funding	*Mark all that apply.* ☒ Grant ☐ Loan ☐ Equity ☐ Guarantees ☐ Others:		
A.9. Division of GCF funding by thematic funding window (if applicable)	______USD or ______ % Mitigation 9,999,042.27 USD or 100 % Adaptation *In case of cross-cutting project/programme, indicate the allocation of funding according to mitigation or adaptation activities. The sum of mitigation and adaptation should add to the amount indicated in field A.7.*		
A.10. Implementation period	5 years *(i.e. From the effective date of the Funded Activity Agreement to the Completion Date)*		
A.11. Total project/ programme lifespan	10 years	**A.12. Expected date of internal approval**	7/1/2019
A.13. Executing Entity information	Department of Science and Technology - Philippine Atmospheric Geophysical and Astronomical Services Administration (DOST-PAGASA)		

A.14. Scalability and potential for transformation (Eligibility for SAP, max. 50 words)

1. The proposed innovation from the current paradigm of hazard-focused forecasting and early warning to one that is impact-based will transform the existing system of end-to-end early warning in the country and how it is implemented, from the way forecasts and warnings and their content are generated to how these are communicated and disseminated to all end-users and utilized to manage climate risks. A multi-hazard impact-based forecasting and early warning system (MH-IBF-EWS) necessitates DOST-PAGASA, the national hydrometeorological warning service of the Philippines and producer of climate and weather information, to generate climate risk information and weather forecasts using probabilistic methodologies to improve accuracy of weather and climate predictions as well as to be actively involved in better understanding societal impacts of severe weather and climate conditions to make the service they provide more relevant to decision-makers and end-users. Alongside these institutional changes in the first mile is the expansion of the role of end-users, namely, the communities at-risk and local decision-makers, i.e. municipal/city authorities, NGOs, and humanitarian agencies working on the ground. An active, well-defined participation and sustained engagement of last-mile stakeholders are a key ingredient in institutionalizing a a people-centered MH-IBF-EWS. This project posits that a people-centered MH-IBF-EWS will bring about more proactive and inclusive climate risk management in the country and contribute to long-term adaptation efforts in the country

2. The project will scale up current initiatives of DOST-PAGASA on hazard and risk assessment, modelling and mapping using a probabilistic approach. It is acquiring a Cray supercomputer, a high performance computing (HPC) system that can provide the necessary computing resource to run an ensemble prediction system (EPS). The EPS will generate the national probabilistic forecasts. This GCF project will leverage on this capability and DOST-PAGASA's ongoing collaboration with the UK Met Office that aims to advance scientific understanding and modelling capabilities needed for impact-based forecasting and early warning for heavy rainfall, thunderstorm and severe wind using Metro Manila and Metro Cebu as study areas. It will also build on the severe wind risk analysis project and climate-adjusted flood hazard modeling study implemented under the RAPID Program[1] in selected municipalities in the provinces of Samar, Eastern Samar and Leyte. Through this GCF project, probabilistic risk assessment and modeling methodologies and tools for flood, landslide, storm surge and severe wind will be developed and standardized. A national interactive multi-hazard map will be generated for primary hazards, i.e. heavy rainfall and severe wind, for all the provinces in the country. Impact-based forecasts and warnings and risk maps at the provincial level will be generated for severe wind by using readily available census data on population and buildings.

3. Applying probabilistic risk assessment, mapping and forecasting at the local (i.e. municipality/city) level using four project sites will demonstrate the transformative effects of a people-centered MH-IBF-EWS. High-resolution risk maps with corresponding detailed impact tables and response tables will be produced with the active engagement of both the communities at-risk and local decision-makers, particularly in crafting warnings and planning early actions during the "window of anticipation." These local-level activities will scale up initiatives on forecast-based early actions or FbA, which includes forecast-based financing. Past and current initiatives of the World Food Programme (WFP), Oxfam, Philippine Red Cross (PRC), etc. implemented in various parts of the country will be utilized to bring FbA to scale so these can be implemented by other local governments in the country, humanitarian organizations, NGOs, donors, etc. depending on context.

A.15. Project/Programme rationale, objectives and approach (max. 250 words)

4. With the projected increase in the intensity of tropical cyclones[2] and associated hazards in the Philippines brought about by climate change and variability, the impacts of severe hydro-meteorological events result to increasing casualties, significant damage to property and infrastructure, and adverse socio-economic consequences for people, business and industry that can persist for many years. This climate-related vulnerability of the country was magnified during the 2013 Typhoon Haiyan (local name: Yolanda), which resulted in 6,293 recorded deaths, 28,689 injured, 1,061 missing, and an estimated infrastructure and agriculture damage of USD 760 million.[3] Accurate warnings on Yolanda's track and intensity and relatively accurate estimates of storm surge height were issued by DOST-PAGASA. However, the information was not sufficient enough for local governments and the public to understand the potential impacts of the hazards and actions they needed to do to protect themselves and their assets. Lessons from Typhoon Haiyan therefore indicate that although forecasts and warnings may be fairly accurate, the lack of understanding of risk

1 Resilience and Preparedness Towards Inclusive Development Program (RAPID) is supported by UNDP and Australian Aid.
[2] Gallo F, Daron J, Macadam I, et al. *High-resolution regional climate model projections of future tropical cyclone activity in the Philippines*. Int J Climatol. 2018;1–14. https:// doi.org/10.1002/joc.5870
[3] NDRRMC Update dated 17 April 2014.

information and its potential impacts remains a challenge. Actionable risk information and warnings and response action are key to the effectiveness and efficiency of EWS. This is the innovative solution that this project proposes to establish by building on lessons, best practices and state-of-the art impact-based multi-hazard early warning system coupled with forecast-based early actions.

5. Moreover, the country is experiencing an increasing trend of damage and losses, for instance, from the impacts of typhoon-induced floods and landslides. Based on the report published by ADB (2018), between 2000 and 2016, these hazardous events caused over 23,000 deaths, affected roughly 125 million people, and about USD 20 billion worth of damage and losses. From these reported damage and losses, 80% of the disasters in the country are caused by hydrometeorological events such as typhoons and floods.[4] With increasing adverse effects of climate change and variability and the Philippines being particularly vulnerable to these hazards even as exposure continue to rise as more people, infrastructure and assets locate and concentrate in hazardous areas, the government and people must ramp up their coping and adaptation strategies to reduce vulnerability to severe weather events, improve climate risk management, and increase resilience. This calls for improving the current EWS in the Philippines at the national and local levels.

6. Lessons from past disasters such as Typhoon Haiyan, the projected increase in the intensity of tropical cyclones, [5,6] and increasing societal losses resulting even from well forecast extreme events necessitate an end-to-end early warning system (EWS) that is multi-hazard in view of cascading or simultaneous impacts of tropical cyclones, floods, landslides, and storm surges. Impact-based forecasting and warning will focus on translating hazard information into likely human, physical, environmental, and economic impacts and the corresponding preparedness, early actions and response to mitigate those impacts. By focusing on impacts, disaster management agencies, local government units (LGUs), and the general public will have a better understanding of the risk and will more likely take appropriate action. Although EWS has been integrated in the National Disaster Risk Reduction and Management Plan (NDRRMP) for 2011-2028[7] and in many local disaster preparedness, response and contingency plans of LGUs, enabling LGUs and national government to institute preventive and preparedness measures to protect lives and properties, the challenge is how national technical agencies such as DOST-PAGASA and DENR-MGB in charge of hydro-meterological warning and geological technical services, respectively, together with OCD[8] and DILG,[9] could provide impact-based forecasts and warnings coordinated by the NDRRMC and take on a more proactive role in climate risk management in the country. Further, impact-based forecasts and risk-informed warnings need to be timely, meaningful and actionable to all end-users, particularly to local decision-makers and communities at-risk. At the local level, hazard forecasts need to be translated into warnings that convey location- and sector-specific impacts, providing tailored climate risk information directly to the LGUs, vulnerable communities, NGOs, humanitarian agencies on the ground and the public. This will improve people's understanding of potential impacts and increase the effectiveness of EWS. The role of last-mile communities, the communities at-risk and local authorities, NGOs and humanitarian agencies on the ground in this kind of EWS is paramount. It requires active participation and sustained engagement of end-users in designing and communicating forecasts and warnings and in planning preparedness measures during normal times and early actions that need to be taken in advance of the event to avoid loss of life and mitigate adverse impacts on livelihoods and properties. A people-centered multi-hazard impact-based forecasting and early warning system will ensure that society's response is commensurate to the risks that threaten communities, government institutions, businesses, and the general public and enable action in advance to reduce the risks involved.

7. This project will address the urgent need for a more proactive and inclusive climate risk management in the Philippines anchored on a people-centered multi-hazard impact-based forecasting and early warning systems (MH-IBF-EWS) for flood, landslide, severe wind and storm surge. A MH-IBF-EWS that is people-centered will increase the availability of, access to, and understanding of impact-based warning, enabling end-users, particularly in the last mile, to reduce their exposure to climate risks, and strengthen their absorptive and adaptive capacities to better manage or adjust to impacts brought about by climate shocks and climate change, and increase capacities to develop long-term climate risk reduction and adaptation measures. To do

4 Jha, S., A. Martinez, P. Quising, Z. Ardaniel, and L. Wang. 2018. *Natural Disasters, Public Spending, and Creative Destruction: A Case Study of the Philippines*. ADBI Working Paper 817 (Tokyo: Asian Development Bank Institute). Available: https://www.adb.org/publications/natural-disasters-public-spending-and-creative-destructionphilippines
5 PAGASA. *Observed Climate Trends and Projected Climate Change in the Philippines.*
6 Gallo, *High Resolution Regional Climate Projections of Future Tropical Cyclone Activity in the Philippines*.
7 The NDDRMP is currently being updated by OCD, with the first draft of the Updated NDRRMP released for discussion by NDRRMC on 4 July 2019.
8 OCD is the executive arm of NDRRMC and national focal agency tasked to coordinate disaster risk reduction and management activities.
9 DILG is Vice-Chair for Disaster Preparedess of the NDRRMC.

so, institutional and technical capacities of government authorities to generate climate risk information and accurate and timely impact-based forecasts and warnings need to be enhanced. Enhanced climate risk information will be utilized in development policy-making and planning processes at national and local levels, while MH-IBF-EWS will be mainstreamed in national climate and disaster risk management frameworks and plans and *in local resilience plans*[10], i.e. local disaster risk reduction and management plans and its variants like disaster preparedness plan, emergeny response plan, contingency plan, local climate change action plans, and other related local plans. A high level of commitment and closer operational cooperation among DOST-PAGASA, DENR-MGB, OCD, and DILG are essential to develop operational plans and SOPs by each collaborating agency to implement a MH-IBF-EWS. Innovative partnerships will be forged as well to foster collaborative work among stakeholders across levels of government, civil society, academia, and communities at-risk, particularly improving risk and warning information with end-user participation, communication, dissemination and information delivery that supports decision-making and planning by all end-users and improving response capabilities of all end-users to reduce loss of life and assets, mitigate anticipated negative impacts of climate-induced hazards before, during and after extreme weather events, and develop a diverse range of proactive climate risk management and adaptation strategies.

8. In order to achieve these, the project will implement four outputs: i) Generating science-based multi-hazard weather and risk information; ii) Establishing a MH-IBF-EWS supported by a knowledge and decision support system; iii) Improving national and local capacities in implementing a people-centered MH-IBF-EWS and forecast-based early actions (FbA); and iv) Mainstreaming climate risk information and MH-IBF-EWS in development policy and planning, investment programming and resilience planning at national and local levels and institutionalizing a people-centered MH-IBF-EWS in the Philippines.

9. The project has two scopes of implementation. At the national level, probabilistic risk assessment, modeling and mapping methodologies, tools and technologies will be standardized for analyzing, monitoring, and forecasting four hazards, i.e. severe wind, storm surge, flood and landslide. This will provide weather forecasts and warnings and climate risk information usable for climate risk management to support the establishment of a framework on impact-based forecasting and early warning system for the country. Weather forecasts and forecast models, probabilistic hazard and risk information, and a nationwide interactive color-coded multi-hazard maps for heavy rainfall and severe wind for all provinces in the country will be generated on a daily basis. For severe wind, provincial-level probabilistic forecasts, risk maps and accompanying general impact tables and response tables will be generated by using census data on population and buildings. These weather and risk information in text and spatial formats will be accessible via a web-based knowledge and decision support system for MH-IBF-EWS. The knowledge and decision support system will enable access to different types of end-users with varying levels of accessibility.

10. The local scope of implementation will comprise of activities involving the four project sites. Project sites will be used to localize the methodologies, technologies and tools for analyzing, monitoring, and forecasting four hazards, i.e. severe wind, storm surge, flood and landslide and further calibrate them. At this level, impact-based forecasts are possible for the four hazards because of the availability of detailed exposure data, which will be collected through the project. Impact-based forecasts and warnings will be produced in text and spatial formats conveyed in detailed impact tables and response tables and maps. The same knowledge and decision support system for MH-IBF-EWS will be utilized to generate and share these information to various end-users.

11. Together with local authorities, humanitarian agencies, NGOs and vulnerable communities in the project sites, impact-based forecasts will likewise be used to identify priority forecast-based early actions (FbA), which includes forecast-based financing and shock-responsive social protection measures, develop an early action protocol (EAP) for the hazards in each project site, determine the triggers for the hazards in each project site that will activate the EAP, and update and mainstream FbA in local resilience plans and relevant development and sectoral plans. The results of these activities at the project site level will further demonstrate the effectiveness, scalability and transformative effects of MH-IBF-EWS.

12. A nationwide capacity building approach will be used to socialize the MH-IBF-EWS framework among all end-users, e.g. national government agencies, local government units (LGUs), humanitarian agencies, NGOs, colleges and universities, donor community, by using the knowledge and decision support system as a training tool. These capacity building activities will ensure that all stakeholders will become aware of the country's shift from a hazard-based to an impact-based forecasting and warning paradigm. These groups of end-users will also cascade their knowledge and training with the people and communities where they operate. At the project site level, stakeholder groups such as local government officers and personnel who are decision and policy makers and planners, i.e. members of the Local city/municipality/barangay DRRM Councils, members of the

Local Development Councils, civil society organizations, humanitarian and donor agencies which operate in project sites, local media, local business sectors, colleges and educational institutions will be trained on impact-based EWS. All sectors of the society will included in the capacity building program. Capacity building activities will be designed to enhance the understanding of impact-based forecasting and early warning, train end-users on how to use the knowledge and decision support system, and facilitate the utilization of the weather and climate risk information for planning and policy-making of different end-users.

[10] **Local resilience plans** is a catch-all term used in this Funding Proposal to refer to all related plans produced by the LGUs in the Philippines such as Local Disaster Risk Reduction and Management Plan (LDRRMP) and its variants such as disaster preparedness plan, emergency response plan and contingency plan, and Local Climate Change Action Plan (LCCAP).

B. PROJECT/PROGRAMME DETAILS

B.1. Context and baseline (max. 500 words)

13. The Philippines is highly vulnerable to sea level rise, increased frequency of extreme weather events, rising temperatures (please refer to Annex 2a, Figures 1a, 1b & 1c), and extreme rainfall[11]. In the 2017 Global Climate Risk Index (CRI), the Philippines ranks as 4th among countries most affected in the period 1996-2015. The country has been identified as a natural disaster hot-spot with approximately 50.3% of its total area and 81.3% of its population vulnerable to natural disasters (World Bank, 2008). Among the hazards identified, typhoons and storms (58% of all disasters in the country), related flooding (25%) and landslides (6%) pose the greatest threats.Based on the EM-DAT 2017, tropical cyclones (TCs) have killed a total of 42,458 people in the Philippines from 1970-2017, while floods killed a total of 3,639 people and landslides killed 2,401 people. In the same period, TCs have affected a total of 162,894,610 people while floods and landslides affected 34 million people and 318 thousand people, respectively.

14. The changing climate is expected to exacerbate these adverse impacts due to increasing severity and frequency of hydrometeorological hazards.Over the past 65 years (1951-2015), there has been an increasing trend in annual mean temperature with an increase of 0.68°C.[12] Compared to the more rapid increase in the annual minimum temperature (0.15°C/decade), the annual maximum temperature has increased at a slower rate (0.05°C/decade).[13] The Philippines also experiences more hot days and fewer cooler nights.[14] Globally, the most recent years of 2015 to 2018 correspond to the four warmest annual temperatures, which is consistent with the country's 10 warmest years occurring over the last decade except in 1998, during the 1997-98 strong El Niño event.[15] Projected temperature increases in 2030's and 2040's is likely to be in the range of 0.49°C–0.99°C and 0.72°C–1.27°C, respectively (assuming the moderate emission scenario, RCP4.5), which may lead to increases in intensity of extreme rainfall and tropical cyclones[16]. Increasing trends in annual and seasonal rainfall were observed in many parts of the country, and found to be associated with extreme rainfall events.[17] Seasonal rainfall during December–January–February (DJF) is observed to be wetter while July–August–September (JAS) shows an increasing trend in intensity for maximum 1-day rainfall (RX1day) and maximum 5-day rainfall (RX5day).[18,19,20] Observed wetter seasons of DJF manifested by continuous heavy rains caused landslides in Panaon Island in 2003 and Guinsaugon in 2006, both in Southern Leyte.[21,22] The 2012 and 2013 "Habagat" events brought widespread flooding, damaged properties, and loss of lives due to the enhancement of the Southwest monsoon.[23] A 20% increase in extreme rainfall is projected over most parts of the country that would continue in the 2030's and 2040's. Likewise, increasing extreme rainfall events (upper bound) for RX1day and RX5day will continue and become more intense under RCP 4.5 scenarios. Continuous trend on intensity of extreme rainfall events may lead to possibility of widespread flooding and landslide events.

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[11] Cinco, T. A., de Guzman, R. G., Hilario, F. D., & Wilson, D. M. (2014). Long-term trends and extremes in observed daily precipitation and near surface air temperature in the Philippines for the period 1951–2010. Elsevier, 12-26

[12] DOST-PAGASA (2018) Observed Climate Trends and Projected Climate Change in the Philippines. Philippine Atmospheric, Geophysical and Astronomical Services Administration, Quezon City, Philippines, 36 pp.

[13] DOST-PAGASA (2018)

[14] Cinco, T., de Guzman, R., Hilario, F., & Wilson, D. (2014). Long-term trends and extremes in observed daily precipitation and near surface air temperature in the Philippine for the period 1951-2010. Elsevier, 12-26

[15] WMO. WMO Statement on the state of the global climate in 2018, Report No. 1233 (World Meteorological Organization, 2019).

[16] DOST-PAGASA (2018).

[17] DOST-PAGASA (2018). Observed Climate Trends and Projected Climate Change in the Philippines. Philippine Atmospheric, Geophysical and Astronomical Services Administration, Quezon City, Philippines, 36 pp.

[18] DOST-PAGASA (2018).

19 Villafuerte , M., Matsumoto, J., Akasaka, J., Takahashi, H., Kubota, H., & Cinco , T. (2014). Long-term trends and variability of rainfall extremes in the Philippines. Elsevier, 1-13. doi:http://dx.doi.org/10.1016/j.atmosres.2013.09.021

20 Villafuerte, M., Matsumoto, J. and Kubota, H. (2015). Changes in extreme rainfall in the Philippines (1911-2010) linked to global mean temperature and ENSO. International Journa of Climatology. 35: 2033-2044. DOI: 10.1002/joc.4105

21 S. G. Evans, R. H. Guthrie, N. J. Roberts, N. F. Bishop. The disastrous 17 February 2006 rockslidedebris avalanche on Leyte Island, Philippines: a catastrophic landslide in tropical mountain terrain.
Natural Hazards and Earth System Science, Copernicus Publications on behalf of the European Geosciences Union, 2007, 7 (1), pp.89-101. ffhal-00299407f

22 Oh, HJ. & Lee, S. (2011) Landslide susceptibility mapping on Panaon Island, Philippines using a geographic information system. Environ Earth Sci 62: 935. https://doi.org/10.1007/s12665-010-0579-2

23 Bagtasa, G. (2019). 118-year climate and extreme weather events of Metropolitan Manila in the Philippines. International Journal of Climatology. https://doi.org/10.1002/joc.6267

15. The observed increase in temperature would also bring warmer sea surface temperature (SST), which is linked to the formation of intense tropical cyclones.24 Tropical cyclones is the most destructive hydro-meteorological hazard that affects the Philippines. Observed trends show a slight decrease in frequency of TCs and an increase in occurrences of strong TCs (exceeding 170kph) consistent with global findings.25,26 In the most recent decade (1990-2015), trend on intense tropical cyclones due to increasing SST is on the rise. TY Haiyan, which occurred during the highest recorded SST in the warm pool region of the West Pacific, caused widespread loss of lives and damage to property.27,28,29 Extreme TCs (wind speeds exceeding 170kph) are also associated with extreme rainfall events all over the country as evidenced by the rampage of Typhoon Washi (Sendong) in 2011 and Typhoon Bopha (Pablo) in 2012, among others.30 Almost 50% of total annual rainfall in Luzon is attributed to tropical cyclones.31,32 Projected slight decrease in TC frequency and increase in strong TCs would most likely continue, consistent with observations. With the projected increase in strong TCs, the potential damage and loss due to floods, rain-induced landslides, and storm surge events would be exacerbated.33 Strong TCs such as the likes of Typhoon Mangkut (Ompong) in 2018 and Typhoon Tembin (Vinta) in 2017 led to significant number of deaths and amount of damage caused by secondary hazards like flooding, strong winds, and storm surge.34,35,

16. With the observed sea level rise (SLR) in the Philippines to be more than twice the global average and the projected 10-20% higher SLR against global averages, destruction brought about by storm surges due to extreme tropical cyclone events will pose greater threats.36 The high rates of sea level rise is a significant factor on the massive storm surge brought by Typhoon Haiyan (2013) which caused enormous devastation.37 A continuous propagation of such climate trends will greatly impact sectors including ecosystems, water resources, agriculture, forests, fisheries, industries, urban and rural settlements, energy, tourism, health, and disaster/emergency management. Please see Annex 2, Section 3 – Observed Trends and Projected Changes for tabulated data, graphs and more details on current climate risks and future climate change.

17. Tropical cyclones accompanied by strong winds, intense rainfall, flooding and storm surge represent the major hydro-meteorological hazards in the Philippines. The climate of the country is strongly affected by rain-bearing (monsoon) winds, which blow from the southwest from May to October and from the northeast from November to February. From January to December, an average of twenty typhoons hit the country, out of which five to seven per year are expected to be destructive. Probably more than temperature change, climate change-induced variability of rainfall is likely to have the greatest impacts in the country. The number of days with heavy rainfall in the latter part of the 20th century appears to be higher than the corresponding occurrence in the early part of the 20th century. Evidence shows that the intensity of extreme rainfall events is changing. Over Luzon, frequent rainfall events of greater than 350 millimeters have been recorded more in the last decade than the 275 millimeters rainfall events of the 1960s and 1970s.38

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24 Gallo, F., Daron, J., Macadam, I., Cinco, T., Villafuerte, M., Buonomo, E., Jones, R. (2018). High-resolution regional climate model projections of future tropical cyclone activity in the Philippines. International Journal of Climatology, 1-14

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26 IPCC. (2013) Climate Change, 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge and New York, NY: Cambridge University Press. https://doi.org/10.1017/CBO9781107415324

27 Comiso, J.C., G.J.P Perez, & L.V. Stock. (2015). Enhanced Pacific Ocean Sea Surface Temperature and Its Relation to Typhoon Haiyan. Journal of Environmental Science and Management, 1-10

28 Cinco, T. A., de Guzman, R. G., Ortiz, A. M. D., Delfino, R. J. P., Lasco, R. D., Hilario, F. D., & Ares, E. D. (2016). Observed trends and impacts of tropical cyclones in the Philippines. International Journal of Climatology, 36(14), 4638-4650

29 Lagmay AMF, Agaton RP, Bahala MAC, Briones JBLT, Cabacaba KMC, Caro CVC, Dasallas LL, Gonzalo LAL, Ladiero CN, Lapidez JP, Mungcal MTF, Puno JVR, Ramos MMAC, Santiago J, Suarez JK, Tablazon JP. 2015. Devastating storm surges of Typhoon Haiyan. Int. J. Disaster Risk Red. 11: 1–12, doi: 10.1016/j.ijdrr.2014. 10.006.

30 Bagtasa, G. (2017) Contribution of Tropical Cyclones to Rainfall in the Philippines, J Climate, 30: 3621-3633, DOI: 10.1175/JCLI-D-16-0150.1

31 Cinco, T. A., de Guzman, R. G., Ortiz, A. M. D., Delfino, R. J. P., Lasco, R. D., Hilario, F. D., & Ares, E. D. (2016). Observed trends and impacts of tropical cyclones in the Philippines. International Journal of Climatology, 36(14), 4638-4650

32 Bagtasa, G. (2017) Contribution of Tropical Cyclones to Rainfall in the Philippines, J Climate, 30: 3621-3633, DOI: 10.1175/JCLI-D-16-0150.1

33 Bagtasa, G. (2017) Contribution of Tropical Cyclones to Rainfall in the Philippines, J Climate, 30: 3621-3633, DOI: 10.1175/JCLI-D-16-0150.1

34 WMO. WMO Statement on the state of the global climate in 2018, Report No. 1233 (World Meteorological Organization, 2019).

35 WMO. WMO Statement on the state of the global climate in 2017, Report No. 1212 (World Meteorological Organization, 2018).

36 Kahana, R., R. Abdon, J. Daron, & Scannell, C. (2016). Projections of mean sea level change for the Philippines. Met Office

37 WMO. WMO Statement on the state of the global climate in 2016, Report No. 1189 (World Meteorological Organization, 2017).

38 Thomas, Albert and Perez. 2013. Climate Related Disasters in Asia and Pacific.

18. The anomalous meteorological-climatological events in 2006 and a subsequent dry spell in 2007 during the rainy season demonstrate the devastating impacts of extreme weather events such as flooding and landslides in the Visayas and Mindanao, and water and power shortages in Luzon.[39] The excessive rainfall which characterized the years 2004, 2006, and 2008 resulted in numerous problems, including (i) the artificial damming of rivers, which breached and led to flash-floods, and the depositing of debris and logs (for instance, in Aurora-Quezon in 2004 and Iloilo on Panay Island in 2008); (ii) the remobilization of lahar deposits, resulting in the avulsion of rivers and flashfloods (for example, the 2006 event in Legazpi City and its vicinity due to Typhoon Reming); (iii) excessive flooding, leading to the destruction of communities along riverbanks, as well as fishponds, agricultural lands, and road and bridge arteries, and isolating villages (such as flooding in the Cagayan River Basin, Pampanga-Agno River Basin, Bicol River Basin and the Jalaur River Basin in Iloilo); and (iv) mass wasting, mostly landslides, which caused great destruction (such as the landslides in Masara in Compostela Valley in 2006 and 2008, respectively).[40] There is a statistically significant relationship between the frequency of intense hydro-meteorological natural disasters, exposure, and climate hazards.

19. Estimates for the period 2001 to 2010 suggest that average rainfall deviation increases by another 8 mm per month (moderate emission scenario) could be associated with an increase in the average frequency of hydro-meteorological disasters in the Philippines by an average of around 0.35 disaster a year, or an additional disaster every three years. If the increase in average rainfall hits 12 mm per month (high emission scenario), an increase of one disaster every two years can be expected.[41]

20. The heavy rains associated with a series of four (4) tropical cyclones in November 2004 and early December 2004 triggered flash floods and massive landslides in the provinces of Quezon, Aurora, and Nueva Ecija. The reported casualties including missing persons reached more than 1,700 persons with about 3 million people directly affected while the estimated damages to agriculture, properties, and infrastructures including the dam at General Nakar amounted to about US$260million. From September until early December 2006, a series of four (4) typhoons battered Luzon and Visayas islands, a record-breaking event in the history of tropical cyclone occurrences in the Philippines. Typhoon Xangsane hit Metro Manila, Typhoon Parma affected Northern Luzon provinces, Typhoon Durian devastated the province of Albay and Camarines Sur, and Typhoon Utor battered Tacloban City, the capital of Leyte province. The total estimated damages from the four typhoons amounted to US$286.96 million, or almost 94% of the total damages for 2006 estimated to be US$306.52 million. On 21 June 2008, Typhoon Fengshen brought untold suffering and devastation to millions of Filipinos nationwide. Its onslaught affected 4.7 million persons with 557 casualties, 826 injured and 87 missing. It also caused one of the worst sea disasters in the country with the sinking of a major passenger ferry carrying toxic chemicals. Total damages to private properties, infrastructure and agriculture amounted to US$293.48 million. On 26 September 2009, Tropical Storm Ketsana brought torrential rains equivalent to one month of rainfall in just 6 hours on the Philippine capital of Manila causing extensive flooding. It affected 4.9 million persons with 464 casualties, and damage to infrastructure and property amounted to US$234 million.

21. Storm surges created by typhoons have struck the country many times in the past. The storm surge with an estimated height between 2.3 and 5 m that devastated Tacloban City and many parts of the Visayas on November 8, 2013 when typhoon Haiyan made landfall was not a unique phenomenon. According to historical records, for instance in 1897 a storm surge hammered Leyte and Tacloban City, killing as many as 7,000 people.

22. In selecting the project sites, the prevailing and future occurrences of climate change induced hazards as well as vulnerability and other socio-economic characteristics of the sites were considered. Exposure and vulnerability to one or two hydrometeorological hazards is one of the criteria, which refers to the frequency of occurrence of relevant hydrometeorological hazards in the project sites and vulnerability to these hazards.This together with other criteria were applied: (i) Highly exposed and vulnerable to one or two hazards; (ii) Representative of urban and rural geographies of the country; (iii) Presence of functional hazard-based early warning system; (iv) Willingness to be part of the project. Based on this set of criteria, four cities/municipalities have been selected as project sites: (1) Tuguegarao City in Cagayan Province – for severe wind and flood; (2) Legazpi City in Albay Province – for severe wind and flood; (3) Municipality of Palo in Leyte Province – for

[39] Yumul. G. et al. 2011. Extreme weather events and related disasters in the Philippines, 2004-2008: A sign of what climate change will mean?

[40] Yumul. G. et al. (2011)

[41] Thomas, Albert and Perez. 2013. Climate Related Disasters in Asia and Pacific.

severe wind and storm surge; and (4) New Bataan in Davao de Oro Province – for severe wind and landslide. Refer to Annex 2, Figure 10 for the map of project sites and further discussion on the selection criteria.

23. With the adoption of Hyogo Framework for Action for Disaster Risk Reduction (HFA) in 2005, the Philippine Government took steps to shift from a reactive approach focusing on disaster relief and response to that of a proactive approach of disaster preparedness and mitigation. The adoption of Republic Act 10121 in 2010 further spurred the paradigm shift to disaster risk reduction and management at all levels of risk governance, though a huge gap between policy and practice still remains today. One of these is the challenge of setting up an end-to-end EWS that delivers accurate and meaningful warning information in a timely manner to authorities and at-risk communities and enabling them to take action. Evenmore so is the challenge of an EWS that is multi-hazard and impact-based that gives the appropriate space and importance to the role of last-mile communities, especially vulnerable groups including indigenous peoples.

24. At present, DOST-PAGASA still operates under a weather forecast and warning paradigm, issuing warnings based on weather criteria for typhoons, floods, and storm surges. Warnings follow a color-coded scheme for heavy rainfall starting in 2012, but it still provides this information based on hazard-based thresholds and lead-times with standardized message content for Metro Manila and areas covered by Doppler radars only, which are then disseminated to the National Disaster Risk Reduction Management Council (NDRRMC) through the Office of Civil Defense (OCD), media, and LGUs. There have been projects related to forecasting and early warning. However these do not focus on multi-hazard impact-based forecasting. Nonetheless, these existing projects complement this proposed project in terms of baseline analysis, lessons learned from the project's implementation and selection of project sites. Training of personnel is also a concern. Forecasting models are available for certain hazards such as flood and severe wind but constantly need upgrading and thus the need for appropriate government investments, including the procurement of monitoring instruments and equipment. Refer to Annex 2a for details on past and current projects.

25. To further improve its forecasting capabilities, DOST-PAGASA recently signed a bilateral agreement and commercial contracts with New Zealand that will help DOST-PAGASA in the dissemination of flood and weather-related information. The MetraWeather, through the New Zealand Met Service, granted DOST-PAGASA the right to use the license for Weatherscape XT. MetraWeather, the international commercial brand of the Met Service of New Zealand, is a global leader in providing innovative weather information services. The said agreement will also enable production of scheduled weather bulletins for a maximum of six (6) minutes per day per broadcaster to be supplied to PTV4, the Philippine government's official television channel.
26. In terms of early warning system, a more proactive approach is yet to develop in many hazard-prone LGUs. Early warning signages like flood markers are only beginning to be put up in areas where recent disasters have occurred. There are only a few good examples where different stakeholders collaborated in disaster preparedness incorporating locally generated early warning systems. A multi-hazard approach would make it possible to build on existing EWS capacities and infrastructure in progressive LGUs.

27. With the passage of Republic Act 10121, the strategy of community-based disaster risk management (CBDRM) as a model to engage communities in DRR and futher decentralize DRR efforts to the LGUs has been given a boost. Though disaster risk management is a devolved function to LGUs, many LGUs still do not have a functional or viable Local Disaster Risk Reduction and Management Offices (LDRRMOs). Further, the quality and capacities of LDRRMOs in the country are still highly uneven. The job of facilitating stakeholder engagement falls mostly on the LDRRMOs, which themselves need capacity building in the area of EWS and community participation.

28. Much work is needed to integrate the EWS in the local disaster risk reduction and management plans or LDRRMPs (including its variants, e.g. disaster preparedness plan, emergency response plan, contingency plans) and local climate change action plans (LCCAPs), not to mention in sectoral plans such as the Comprehensive Development Plans and annual investment programs. Forecast-based early actions and financing is a relatively new strategy that most LGUs are not familiar with.

29. During strong typhoons, communication facilities break down. Some LGUs do not have an alternative system to communicate warnings to residents and inform when to evacuate in advance of the event. Warnings are still usually received through traditional medial channels such as TV and radio. Private cellular companies have agreements with the government to deliver warning text blasts to mobile phones as alerts broadcast by cellular towers within risk areas. Information delivered on mobile phones contribute to a multi-source delivery system, building on more traditional sources such as television and radio broadcasts. Increasingly being used is the Internet, particularly social media such as Facebook and Twitter. However, for remote villages living in the

countryside, such as indigenous communities who do not have the means to receive or access weather forecasts and early warning information even through common means such as TV, radio, and cellphone, there is a bigger challenge of making the EWS system more inclusive. Many stakeholders are now demanding access to risk information. Data/information on hazards and vulnerabilities at the local level are not available except in those areas where projects, usually donor-funded, were implemented . While the need for a climate and disaster risk information system is recognized, there is no still coherent strategy towards putting up such a system.

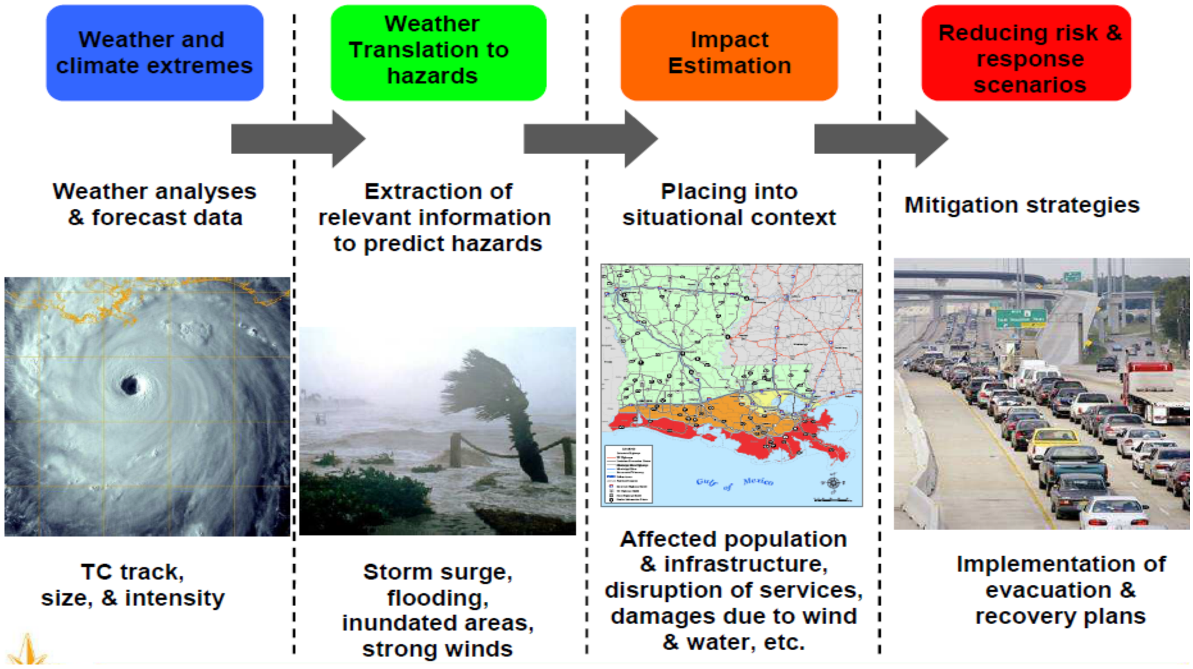
B.2. Project/programme description (max. 1,000 words)

30. The objectives of this project are to reduce the exposure of vulnerable communities to climate-induced hydrometeorological hazards, strengthen their absorptive and adaptive capacities to better manage or adjust to impacts brought about by climate shocks and climate change, and implement long-term climate risk reduction and adaptation measures. To achieve these objectives, the project will implement the following four main outputs with corresponding activities:

    i. Generating science-based multi-hazard weather and climate risk information
    ii. Establishing a multi-hazard impact-based forecasting and early warning system (MH-IBF-EWS) supported by a knowledge and decision support system.
    iii. Improving national and local capacities in implementing a people-centered MH-IBF-EWS and forecast-based early actions (FbA).
    iv. Mainstreaming climate risk information and MH-IBF-EWS in development policy and planning, investment programming and resilience planning at national and local levels and institutionalizing a people-centered MH-IBF-EWS in the Philippines.

31. The outputs of this project follow the elements of impact-based forecast and warning services recommended by WMO as depicted in the diagram below [42]. The proposed approach adopts the best available science and technology developed by WMO and partners to establish a multi-hazard impact-based early warning system consisting of impact-based forecasting and FbA. Output 1 of the project will generate science-based multi-hazard weather and climate risk information will be the remit of DOST-PAGASA, focusing on weather analysis and forecast data and improving observing, modeling, and predicting severe weather and climate extremes. On a national scale, this will include severe wind and heavy rainfall. At the local level, severe hazard phenomena information considered in the project such as flood, landslide, storm surge and severe wind will be translated into more usable information, which is in terms of potential impacts, with the availability and use of exposure data of the four project sites. These translation into risk-based warning in terms of impact estimation is done by placing hazard-based forecasts into situational context using exposure data such as population, housing and infrastructure, road networks, etc. and their vulnerabilities to these hazards. Outputs 1 and 2 below further elaborate on these elements, including a common understanding of the decision-making processes involved in implementing MH-IBF-EWS. Under Output 2, co-development of risk matrix, impact tables and response tables for all hazards with key collaborating agencies of NDRRMC such as OCD and DILG will be done at the national level. A national framework for MH-IBF-EWS will be developed and adopted by the NDRRMC. At the project site level, the concerned LGUs, local NGOs and community stakeholders will use this risk matrix as model. The establisment of a high performance computing infrastructure with big data analytics provides enormous computational power to improve forecasting performance. Output 3 of the project underlines the application of impact-based forecasting and warning in enhancing disaster preparedness and early action through the development of forecast-based early actions and financing (FbA) for each hazard and implementation of FbA protocols. The implementation of MH-IBF-EWS and FbA requires closer operational coordination and partnerships among forecast providers, local and national decision makers and end-users that will be institutionalized by establishing formal coordination mechanisms and SOPs, as described in Output 4 of the project. See Figure 15 in Annex 2a which depicts in a simpler way the process of shifting from a hazard-based to impact-based forecasting and early warning system service and underlining the importance of the role of end-users of warning information to minimize potential impacts.

[42] WMO. 2015. Guidelines on Multi-hazard Impact-based Forecast and Warning Services, 2015.



Source: Haleh Kootval, WMO, Impact-based Forecast and Warning Services, Curacao, October 2016.

32. **Output 1: Science-based multi-hazard weather and climate risk information is generated.**

The project will allow the Philippines to adopt a new model for weather forecasting and early warning system that is multi-hazard and impact-based. Explicit in this approach is the need to shift from deterministic to probabilistic forecasting techniques that highlight not only the most likely impact, but also reasonable worst-case scenarios, which are often the cause of avoidable disasters. Adopting a probabilistic approach instead of the traditional deterministic approach leads to better forecasting performance and actionable warnings for effective disaster risk reduction.
This output will generate a science-based understanding of the hazards, i.e. flood, landslide, severe wind, and storm surge, exposure and vulnerability. Scientifically-derived weather and climate risk information are necessary in generating accurate and timely impact-based forecasts and warnings, an essential input in establishing a MH-IBF-EWS.

At the national level, probabilistic risk assessment, modeling and mapping methodologies, tools and technologies will be developed and standardized for analyzing, monitoring and forecasting four hazards, i.e. severe wind, storm surge, flood and landslide. Probabilistic hazard assessment and modelling will be undertaken for severe wind and heavy rainfall targeting all provinces in the country. For severe wind, probabilistic forecasts will be done on a daily basis. Probabilistic forecasts will be displayed using interactive risk maps showing different levels of risk within each province. Colors will be used to indicate the levels of risk on the map. Though this will use more generic assumptions about exposure by using government census data on population and buildings at the provincial level, the impact-based forecasts and warnings will still be able to alert all end-users, particularly communities at-risk, local decision-makers, NGOs, humanitarian agencies on the ground, and the general public to the possible occurrence of severe weather and its potential impacts for each level of risk. For heavy rainfall, probabilistic forecast maps will be produced for all provinces in the country. Interactive probabilistic hazard forecast maps showing the intensity of the hazard will be depicted using colors and generated on a daily basis as well.

At the local level, in the four project sites in particular, probabilistic risk assessments and mapping will be undertaken. Project sites will be used to localize the methodologies, technologies and tools for analyzing, monitoring, and forecasting four hazards, i.e. severe wind, storm surge, flood and rain-induced landslide and further calibrate them. At this level, impact-based forecasts are possible for the four hazards because of the availability of detailed exposure data, which will be collected through the project. Probabilisitic forecasts of the four hazards will also be generated and visualized through interactive high-resolution risk maps of the project sites. Local probabilistic forecast maps of each hazard will show the varying risk levels within the project sites using color codes with accompanying impact-based forecasts and warnings generated on a daily basis.

All outputs that can be visualized and displayed in both text and spatial form will be shared with and be accessible to all end-users of the informaiton, i.e. decision-makers (local and national authorities, NGOs, humanitarian agencies) and at-risk communities through the use of a knowledge and decision support system that will be developed under Output 2.

1.1 Assess, install and upgrade observation networks in the project sites

The development of observation and monitoring systems will be undertaken to provide necessary reliable data. This activity will expand and upgrade the hydrometeorological network covering multiple climate-induced hazards (flood, landslide, storm surge, severe wind) based on an assessment and conduct of inventory. The observation network will include all weather parameters to provide an appropriate level of spatial resolution for probabilistic forecasting and local risk assessments in the project site. These installations will also contribute to the global observing network and increase performance of global forecasts (e.g. hurricanes, El Nino) as well as the downscaled local forecasts providing an essential national and global public good.

Early warning systems such as Automatic Weather Stations (AWS) will be installed in all of the proposed project sites following the standard specification requirements of the World Meteorological Organization (WMO) of a 10-meter height over open terrain. Other hydro-meteorological equipment such as water level, tide gauges, landslide monitoring devices will be procured and installed in the project sites. Below is the initial estimate on the number of hydro-meteorological equipment to be installed, which will all be procured and funded/co-financed by PAGASA:

1 AWS - Tuguegarao City
1 AWS - Legazpi City
1 AWS, 2 Tide Stations - Municipality of Palo
1 AWS - Municipality of New Bataan
3 units Landslide Monitoring Device (Real Time Kinematic GPS and Terrestrial Laser Scanner)

The actual number of early warning equipment to be installed will be determined during project implementation, after ground verification and actual data needed for Numerical Weather Prediction have been validated.

1.2 Establish threshold values that will cause flooding, storm surge and landslide in the project sites

Technical analysis and review of the historical meteorological events that caused flooding, storm surge and landslide will be undertaken to determine the threshold values for each hazard for each project site.

1.3 Generate probabilistic hazard maps for severe wind, storm surge, flood and landslide in the project sites

Different return periods for heavy rainfall and severe winds will be calculated to generate probabilistic hazard maps for storm surge, flood and landslide through surveys and modelling of identified project sites. These hazard maps are used for the assessment of current and future hazard scenarios and the design of climate risk management solutions that fully account for climate change considerations. These probabilistic hazard maps are inputs to development/sectoral planning, investment programming and resilience plans at national and local levels of the Output 3 of this project.

1.4 Generate national probabilistic weather forecasts for heavy rainfall and severe wind using numerical weather prediction (NWP) at the national level.

The advances in the science of climate modelling and numerical weather prediction are making weather forecasting more accurate. Establishing an ensemble forecasting system greatly increases the robustness and utility of the forecasts as it provides a range of possibilities for decision making. This system will also increase the leadtime to allow space/time for better planning and response. Upgrading the computational capacity of PAGASA is needed to provide accurate and timely weather forecasts necessary to provide site-specific hazard impacts with increased accuracy of likelihood of occurrence. With the supercomputer that will enable forecasters to have more accurate forecasts of the likelihood of the event, the accuracy of the forecasts of potential impacts will not be compromised, which will lead to increasing confidence of end-users in the warnings and end-users making decisions based on these warnings to take early actions and mitigate potential impacts after warnings have been received.

This activity will generate ensemble prediction that allows more rapid and scientific-based comparison of multiple model forecasts, and thus provide a more robust estimate of uncertainties presented by the models' initial conditions, dynamics and physics, and atmospheric predictability. A 4x4 km ensemble system fed from the Met Office Global Ensemble system will be used. This system will be implemented in DOST-PAGASA's Cray Integrated High Performance Computing (iHPC) system.The likelihood of the threshold derived from Output 1.2 for flood, landslide, storm surge, and severe wind will then be derived with associated likelihood of happening five days or more in advance.

1.5 Generate localized flood, landslide, storm surge model forecasts and national severe wind model forecasts for project sites.

Under this activity, localized flood and landslide forecasts will be generated on a daily basis using hydrological models. For storm surge forecasts, most appropriate storm surge models will be used. National severe wind forecasts using Unified model of UK Met Office will be generated on a daily basis. Ensemble model outputs will be generated for the four hazards.

This will build on the DOST-PAGASA and the UK Met Office (UKMO) successful partnership. UKMO was contracted by DOST-PAGASA to provide weather and climate information services utilizing the Unified Model (UM) system delivered from the UKMO headquarters. Thereafter, the Philippines and the Philippine Area of Responsibility (PAR) convective scale ensemble systems for various trial periods has been running. The ensembles have generally provided a good estimate of uncertainty for various high impact weather cases, such as tropical cyclones and surface water flooding. While the model can at times be a little under spread in certain weather cases, it has proved highly valuable in providing uncertainty information around the deterministic model and in several cases the ensemble system identified very high impact events that at the same lead time are not captured in the deterministic model.

1.6 In the case of identifying Tropical Cyclones, the model has been shown to capture rapid intensification which is not possible with similar global modeling systems. These if anything are a little overdone and the risk identified as a little too high in the ensemble system. However, convective scale ensembles remain very valuable to the forecasters and as the model is being developed all the time this overestimation of extreme events may well improve in updated versions. In terms of intense precipitation from tropical convection, again the model does not underestimate the frequency of these extreme events. Certainly, forecasts from an ensemble system are probabilistic so any individual event cannot be evaluated in isolation. During project implementation, the project will remain aware of the limitations of the ensemble approach.*Build exposure database at the barangay level in project sites.*

In order to effectively generate risk information, a detailed exposure database is needed. For local data in the project sites, existing exposure databases will be updated and improved using already existing tools, e.g. ClimexDB, REDAS, or any available tools in the project sites. An exposure database will be develop by the LGUs. It will contain data on population, assets and activities including administrative boundaries, land ownership, building construction statistics, and socio-economic characteristics.

Capacity building for LGUs in generating exposure database will be conducted to ensure long-term sustainability. Maintenance and continuous updating of their exposure database will be done by the respective LGUs in the project sites.

1.7 Update/develop vulnerability and fragility curves for structures/buildings for severe wind, storm surge, flood and landslide.

Vulnerability models are used to estimate how much damage occurs to a given building type subjected to severe wind speeds, floods, storm surge and landslide. This is normally shown using a vulnerability curve. Incorporating the vulnerability curve into the building exposure data that provides the characteristics of buildings in a community and overlaid by the hazard map will yield information on areas that will be highly damaged.

Bulding structures also behave differently, depending on its characteristics. These conditions of vulnerability generally define how elements are affected by a hazard. Local scientists and engineers from University of the

Philippines and Philippine Institute of Civil Engineers jointly developed vulnerability curves for different building types. This resulted to a closer approximation of how much damage to building will be incurred at a certain wind speed and flood depth. Vulnerability and fragility curves for severe wind and flood have already been developed for 17 building types identified to be typical in the country but need to be updated. The project will thus leverage local expertise, lessons and best practices to build systems informed by local knowledge and circumstances. The project will update these knowledge, tools and database and create a sustainable system through active engagement of researchers and practictioners. Vulnerability and fragility curves for storm surge and landslide for the 17 building types will be developed. If other types of structures not included in the 17 building types were to be found in the project sites, vulnerability and fragility curves will be developed for these as well.

Combining the outputs of this activity with the detailed databases of each project site produced in Activity 1.6 and the probabilistic hazard maps produced in Activity 1.3 above, static probabilistic risk maps of the project sites will be developed. For instance, for severe wind risk analysis, the direct impact of severe wind due to tropical cyclones can be translated to a potential damage to buildings, which can be further expressed in terms of economic loss. The risk maps for the four hazards can be used by the LGUs concerned in conducting their own analysis and develop appropriate risk reduction and adaptation measures for the long-term, such as strengthening vulnerable housing structures, retrofitting critical facilities and lifelines, guide decision-making disaster response operations, and enhance their local resilience plans.

1.8 Undertake risk analysis incorporating hazard, exposure and vulnerability and assess socio-economic and gender vulnerability to identify potential impacts from extreme weather events in the project sites

This activity will involve compilation of various datasets available for characterizing hazard, vulnerability and exposure to develop a tool in quantifying risks, i.e. potential impacts. This tool will therefore be used to analyze exposure and determine potential physical, environment, social and economic impacts in the four project sites due to their respective hazards. This risk analysis tool or methodology will be used in generating impact-based forecasts and warnings and visualization maps through the knowledge and decision support system that will be developed in Output 2.

33. **Output 2: Established MH-IBF-EWS supported by a knowledge and decision support system.**

The project will establish a MH-IBF-EWS in the country. A national framework will be developed in order to guide all national government agencies, local government units, NGOs, academe, business and the public on the implementation of the EWS. At the local level, MH-IBF-EWS will improve availability and accessibility of impact-based warnings to end-users, particularly the last-mile communities, in a more meaningful and actionable manner.

A big part of the output is a knowledge and decision support system for meteorological operations to provide an online multi-user tool that supports multi-hazard early warnings, information and data services and impact-based forecasting which will improve decision making in climate risk management. Improved computational resouces and knowledge will enable high-resolution forecasts and warnings at the interventions scale, accurately capturing the spatio-temporal details of extreme events/hazards and impacts. Significant reduction in error will lead to efficient interventions saving lives, livelihoods and assets.

The database platform consists of historical and real-time data and socio-economic data collected and sourced from different agencies and sectors. Location-specific information such as topography, watershed extents, flood, landslide, severe wind and storm surge hazard maps, population demographics and critical infrastructure are presented as overlays within the geo-spatial environment to rapidly analyze exposure as well as physical and social vulnerabilities and facilitate the quantification of impacts. The combination of evolving hazard data supports the rapid identification of exposed assets and provides a powerful workflow for forecasting social and environmental risks. Forecasting impacts will then be more understood by those at risk and those responsible for mitigating risk so that they can prepare and take appropriate early actions. An informed population that fully understands what a hazard will do is more likely to take the necessary actions that protect lives and livelihoods.

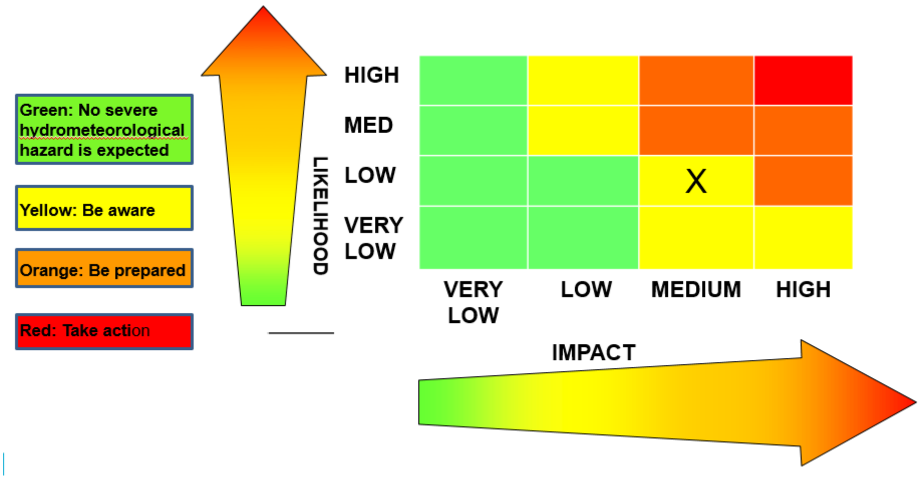
This will also aid in integrating climate risk information in local planning and programming to increase the communities' risk reduction efforts and enhance their adaptive capacity. Under this output, co-development of user-validated risk matrix, impact tables and responses table for all hazards at the national and local levels will be done. This requires a closer collaboration and partnership between forecast providers, decision makers and end-users.

2.1 Develop the impact-based forecasting and early warning system for each hazard

This activity will support the development of a national framework for MH-IBF-EWS for the country and guide the implementation at the local level. This involves the development of the risk matrix with agreed risk levels and color codes and accompanying general impact table and general response table for each hazard in collaboration with key national and local stakeholders. These risk matrix, impact table and response table will be used as a template by the project sites and other LGUs that will implement MH-IBF-EWS in the future.

The operationally-designed decision support system will translate real/near-real time science-based weather forecast information into potential impacts and response advisories for dissemination to OCD, DILG and the NDRRMC as well as LGUs and all stakeholders in the project sites. By establishing an intelligent meteorological system using validated numerical weather prediction models and other ensemble and probabilistic models and sophisticated weather observation systems, certain thresholds can be determined corresponding to certain degree of likelihood of an expected hazard and its severity in tandem with the degree of potential impacts to generate the risk matrix. This can be supplemented by the high forecasting skills of meteorologists and atmospheric scientists.
Once the likelihood of an expected hazard and the potential impacts are determined using impact assessment models, appropriate colors can be marked on the risk matrix and color-coded warnings can be issued to the general public. To provide easy-to-understand information, action focused warnings in textual forms can also be converted into maps to visualize at a glance the geographical extent of the hazard and the color-coded warnings are reflected in the risk matrix in the web-based platform that are readily accessed and understood by local communities. Each color suggests corresponding response mechanisms necessary for communities at-risk, local and national decision makers, humanitarian agencies, and emergency managers and responders on the ground to proactively implement mitigation measures or early actions in advance of the event.

The risk matrix as shown in the figure below will be color coded to depict risk levels and corresponding warnings, i.e. Green – Very Low, Yellow – Low, Orange – Medium, Red – High Risk. It will identify the likelihood of a specific hazard event or multiple events and the potential impacts. Impacts are determined by integrating forecasts with exposure and vulnerability data and can identify specific groups of people or communities at risk. Graphical warning maps will be displayed and shared in the knowledge and decision support system (See Output 2.5).



Source: WMO.

2.2 Develop/update early warning protocols from hazard to impact-based using collaborative approaches for the project sites

Impact-based warning protocols will be developed and adopted by government through the NDRRMC for issuance, communication, and dissemination for each hazard in the identified project sites. An interagency committee for operationalizing MH-IBF-EWS (see Output 4) will be responsible for coordinating this work together with the LGUs and stakeholders in the project sites.

2.3 Develop and adopt national policy framework on MH-IBF-EWS to guide the implementation of national government, local government units and all stakeholders nationwide

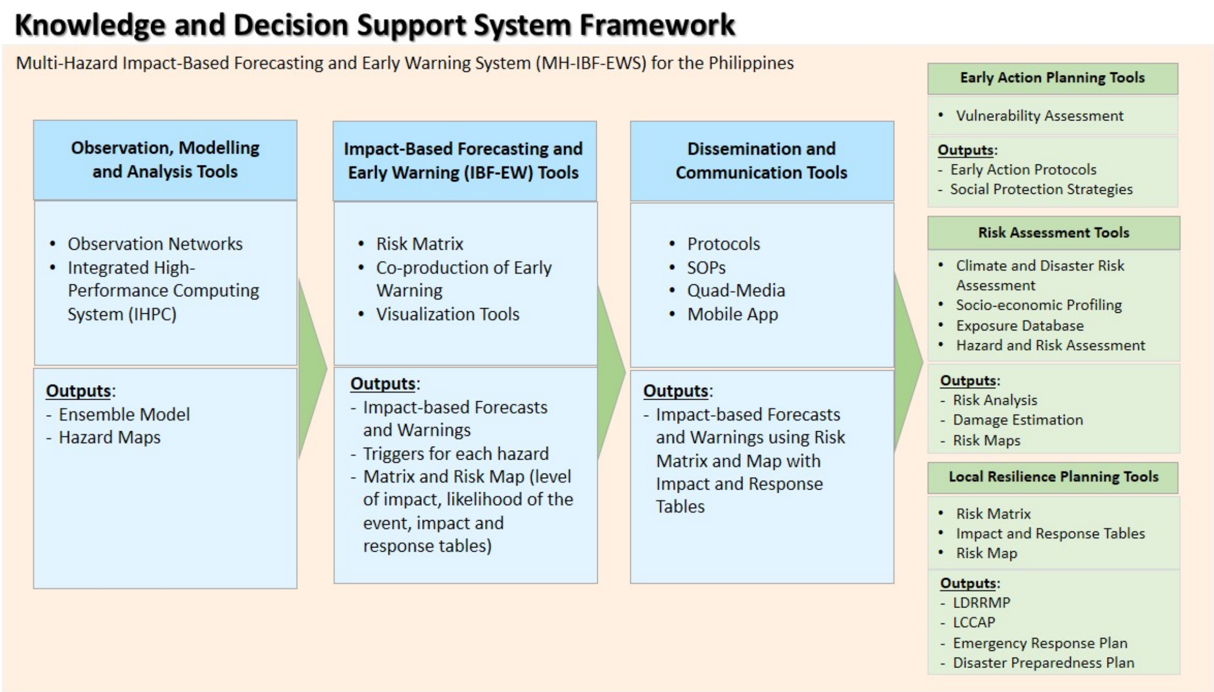
Developing a jointly designed national framework on MH-IBF-EWS and corresponding guidelines including a readiness checklist for implementing MH-IBF-EWS by LGUs will be done in order to provide a common and collective understanding the EWS and facilitate the implementation of impact-based warning services.

2.4 Test and validate the impact and response tables of the project sites.

Testing and validating the impact and response tables on early warning in project sites will be done in a collaborative and participatory manner. The shift to impact-based forecasting and warning will require a design of EWS that explicitly incorporates the decision-making contexts and risk perceptions of vulnerable communities. As end-users of the last-mile of EWS, vulnerable communities will be sustainably engaged and consulted to ensure that the design of the EWS will be optimal for relevance and use. The content of warning messages will be designed to be responsive to the needs of vulnerable communities, while making sure that these are effective and actionable. Appropriate channels of information or how these warnings will be disseminated and delivered in a timely manner will be incorporated in the design of the EWS, including provisions of end-user feedback mechanisms. With various technologies available at present, it is important that warnings are received by end-users in ways that they expect, using technology with which they are familiar. This will be undertaken in conjunction with Activity 3.3.

2.5 Develop a knowledge and decision support system to support the implementation of MH-IBF-EWS

The implementation of a multi-hazard impact-based forecasting and early warning approach involves new types of meteorological and hydrological forecasting and warning information services as well as new visual and practical presentation of information, including maps, user-specific graphics and weather symbols. This will require the development of a new web-based system that is available to DOST-PAGASA and all end-users. The figure below shows the different tools that comprise the knowledge and decision support system that will be developed by the project.



In the figure above, the first column corresponds to DOST-PAGASA's existing technologies and tools for gathering weather and climate data and producing science-based hazard information using computing systems (i.e. contribution to the project as co-financing). These data will be processed and analyzed to come up with probababilistic hazard forecasts using models.

To support the development and implementation of multi-hazard impact-based forecasting and early warning services, the project will establish a web-based knowledge and decision support system consisting of tools and functionalities (i.e. second, third and fourth columns) that will provide hazard and risk information, interactive probabilistic forecast maps showing risk levels for all provinces in the country and more detailed forecast maps initially limited to four project sites with corresponding timely and actionable impact-based forecasts and warnings. These Impact-Based Forecasting and Early Warning tools consisting of risk matrix, visualization tools (e.g. GIS maps at different scales) and co-production of early warning messages wil aide in the issuance of impact-based forecasts and warnings usable to end-users.
The KDSS is mainly meant for government agencies at the national, provincial and local levels to serve as a tool in decision- and policy making, analysis and planning. All the city/municipal governments in the project sites have the necessary equipment and access to the Internet. The mobile application version will be available to the public. For community stakeholders, as mentioned in the response to Question 1B above, for remote populations including IP communities without Internet access,, traditional broadcast media such as radio and TV depending on the results of stakeholder consultations will be utilized as these are the main sources of news of the population. Increasing the accessibility of at-risk communities to warning information (local and IP communities alike) is part of the project and will be done in collaboration with the LGUs within the context of capacity building. For instance, for remote IP villages in the uplands, strategic areas with radio signal in and around the villages could be provided with solar-powered AM/FM radio as well as single-side band radios to the IP community leaders by the LGU concerned. Feedback mechanisms will be included in the EWS to take into consideration the specific needs of the IP in terms of receiving information tailor fit to their context.
The system will also have Dissemination and Communication Tools as the means through which impact-based forecasts and warnings are issued and disseminated to all end-users such as vulnerable communities, government agencies involved in disaster risk management and the general public. Protocols and SOPs will be communicated and disseminated to end-users to help them take necessary preparedness and early actions in advance of the event to minimize or avoid losses and damage to assets. The system will also have a user-friendly mobile application tool for visualizing impact-based forecasts and warnings. This will be designed to increase public engagement and feedback from end-users to transform the way climate risk information is communicated and be usable to end-users.

Communication and dissemination as an integral part of the EWS will utilize all types of media and channels to reach the project sites, especially those in remote locations, whichever modalities are deemed appropriate by the end-users and last mile communities at-risk, (e.g. satellite and mobile-cellular networks, social media, flags, sirens, bells, public address systems, radio, TV, door-to-door dispatch). Communication strategies will be evaluated to ensure messages will reach the communities in a timely manner. Agreements to utilize private sector resources where appropriate (e.g. mobile-cellular, satellite, television, radio broadcasting, amateur radio, social media) to disseminate warnings will be established.

In the Philippines, forecasts and warnings are traditionally disseminated through TV and radio broadcasts. Based on 2012 statistics, with a population of 96.7 million, the Philippines had 16.9 million TV households by the end of 2012, representing a TV household penetration rate of 79%. Television has long been the dominant media form in the Philippines and also the main source of news for the majority of Filipinos. [43]Figures from global market research firm Synovate show that in 2011 free-to-air TV penetration was around 98%. [44] In 1994, among Filipinos aged 10 years old and over, approximately 8 out of 10 (80.8 percent) or 40.7 million listened to radio. [45]These figures were expected to increase in the future. In terms of digital media, the Philippines is one of the top 10 Facebook users in the world, with 68 Million Facebook users as of July 2019. [46]It is also estimated that by 2021, smartphone users in the Philippines will hit 90 million, from just 40 million in 2016. [47]
The project will, in short, use all available mass media such as traditional media, i.e. TV and radio, and take advantage of the popularity and availability of other platforms and means of communication such as cellphones and social media (accessed mainly by smartphones) such as Facebook among Filipinos, which are gaining ground due to faster and more affordable data services.

For remote populations, including IP communities, indigenous knowledge, systems and practices would be assessed and possibly be complemented with traditional broadcast media such as radio and TV depending on

[43] CASBAA. Philippines in View, CASBAA Market Research Report. 2014. Hongkong.
[44] https://oxfordbusinessgroup.com/overview/tuning-radio-and-television-remain-strong-print-declines).
[45] https://psa.gov.ph/content/exposure-population-mass-media).
[46] https://www.statista.com/statistics/268136/top-15-countries-based-on-number-of-facebook-users/).
[47] http://nine.cnnphilippines.com/business/2016/07/12/smartphone-users-90-million-in-five-years.html).

the results of stakeholder consultations. Increasing the accessibility of at-risk communities to warning information, local and IP communities alike, is part of the project and will be done in collaboration with the LGUs within the context of capacity building. For instance, for remote IP villages in the uplands, strategic areas with radio signal in and around the villages could be provided with radio by the LGU concerned. IPs are represented in the LDRRMC. It is assumed that the proportion of population with internet access and smartphones at the national level also apply at the project site level, since disaggregated data at the municipal/city level are not available.
This knowledge and decision support system will also integrate Risk Assessment tools that will enable decision-makers to analyze their risks and enhance their climate risk management efforts from preparedness to early action to emergency response as well as for long-term development and adaptation planning. This decision support tool will be accessible to emergency managers at the national level such as OCD, DILG and other key agency members of the NDRRMC as well as for the LGUs in the project sites.

Local Resilience Planning tools for use by LGUs and local decisions makers to enable them to understand their risks will also be integrated into this knowledge system. Users will be able to store, organize and manage data required to assess exposure and risks of their localities. By overlaying the hazard maps produced by DOST-PAGASA, local decision makers, disaster risk managers and emergency responders will be able to estimate potential impacts and identify measures that can minimize these impacts in the future. This knowledge system will also help in participatory vunerability assessment and resource allocation to support the implementation of forecast-based early action protocols including social protection strategies that are agreed by at-risk communities in the project sites.
A central standardized repository (including but not limited to a Geographic Information System) will be established to store all risk information. On this project, the technical capacities of DOST-PAGASA, DENR-MGB, DILG, LGUs, OCD and NGOs on the use, operation, and maintenance of the KMP platform as well as the DSS will also be enhanced. This will allow to replicate the use of the DSS to other LGUs. The KDSS can work both online and offline. Access to information and to KDSS will be part of capacity building of the LGUs in the project sites. Capacity building is not only on the training of LGUs to use KDSS but also on improving their systems, including technological systems, up to par so they can implement IBF-EWS.

The system will be continuously calibrated and upgraded beyond project life and add more detailed local risk maps of the rest of the cities and municipalities in the country as high-resolution exposure data are gathered by local governments, DOST-PAGASA and other actors. It will also be used as a tool in training and capacity building activities on MH-IBF-EWS in the project sites that will eventually expand to provinces where they belong and nationwide thereafter.

The platform will be equipped with a Common Alert Protocol (CAP) broker and document producer for integration with regional CAP compliant systems.

2.6 *Conduct simulations to test the MH-IBF-EWS and calibrate knowledge and decision support system the system on a regular basis*

Assessing the performance of an impact-based forecasting and warning system and services will be done regularly. A manual of operations for the system will be developed and continuously updated.

34. **Output 3: Improved national and local capacities in implementing a people-centered MH-IBF-EWS and forecast-based early actions and financing (FbA).**

Capacity building to enhance institutional and technical capacities of DOST-PAGASA and the Co-executing Entities, end-users and other relevant stakeholders will be undertaken to ensure the effective operationalization of the MH-IBF-EWS and FbA down to the last mile. This capacity development program includes the conduct of trainings and knowledge sharing activities, developing/harmonizing protocols and SOPs, and updating/enhancing local resilience plans as described in Output 4.

Improved capacities will enable the mainstreaming of MH-IBF-EWS for enhanced risk-informed development and investment plans and policies as well as enhancing local resilience plans under Output 4. Improved capacities will also make multi-sectoral partnerships, including public-private partnership to be forged in Output 4 more fruitful and productive.

3.1: Conduct a gap assessment on MH-IBF-EWS of key national and local end-users.

A gap assessment of DOST-PAGASA, DENR-MGB, DILG, OCD and LGUs in the project sites will be conducted to determine their existing capabilities and available resources needed to implement a people-centered MH-IBF-EWS and Forecast-based financing and early action (FbA). For instance, this will involve the determination of the state of affairs of the technical capacity (e.g. availability of instrumentation and facilities, human resources), communication and dissemination channels for early warning, existing policies, SOPs and protocols related to EWS, institutional capacities and resource allocation for climate risk management, among others. This will include an assessment of how the indigenous communities living in the project site of New Bataan are currently engaged in the existing EWS of the municipality.

3.2 Build gender-sensitive institutional and technical capacities to implement MH-IBF-EWS.

Based on capacity gap assessment results, a gender-sensitive capacity building plan will be developed for targeted groups and training modules will be developed/updated. Trainings, workshops and knowledge sharing activities will be conducted for specific groups such as forecasters, key national agencies, LGUs, communities at-risk and indigenous communities, and key business sectors in project sites to increase their understanding of and knowledge on impact-based forecasting and early warning and on forecast-based early actions and financing. In the case of indigenous communities in New Bataan, the project will learn and build on the positive aspects of their traditional practices and values to ensure that the indigenous communities will in turn understand and appreciate the new concepts (e.g. climate change, climate projections) and tools (e.e. vulnerability assessment) that the project will introduce.

One approach of the project to scale up capacity building activities is by inviting the mayor and LDRRM officers of all cities/municipalities in the provinces of Cagayan, Albay, Leyte and Davao de Oro as well as the governors and Provincial DDRM officers to all the trainings and workshops that will be conducted in the project sites. In this manner, MH-IBF-EWS will be socialized and promoted to the whole province and not only in the project sites.

3.3. Develop localized impact tables and response tables for each hazard for the four project sites.

Impact-based forecast and warning require the translation of hazard jargon into timely, meaningful and actionable information about the likely impacts of a hazard. More quantitative impact-based forecasts will consider the vulnerability of specific locations, e.g. elevation and risk of flooding, type and quality of buildings to withstand severe wind and floodwaters, vulnerability of lifelines and critical infrastructure such as hospitals, schools and other public services, as well as the capacity of government and people to respond. Localized impact tables and response tables will also include the vulnerability of livelihood activities (e.g farming and fishing) so that impact-based forecasts and warnings are tailored to the needs of those at-risk, i.e. last-mile communities as well as local decision makers including local authorities, humanitarian actors, and local NGOs operating on the ground. Indigenous communities will also be actively engaged in the co-production of impact and response tables that will consider indigenous knowledge, systems and practices of community members.

This activity will focus on the development of a people-centered EWS by tailoring of messages, identifying the best channels for dissemination, and collecting feedback from end-users to improve the system. Activities will ensure co-production of messages through active participation of at-risk communities (i.e. indigenous communities in New Bataan) and establishment of a feedback mechanism. The establishment of feedback mechanisms will also enhance the usability of scientific information by combining it with local and indigenous knowledge. Existing cooperation and partnerships of government agencies with the academe and private sector, particularly those involving communication and dissemination of early warnings, will be further expanded or strengthened.

Under this activity, the LGUs, DILG and WFP will convene various stakeholders to guide project implementation to ensure participation and the mainstreaming of gender, social protection and accountability to affected populations in the development of solutions for the last mile. A comprehensive baseline assessment of communities at-risk as well as key local institutions will be conducted to understand their vulnerabilities and capacities. A risk perception survey will also be conducted in the project sites to determine suitable and effective messaging and means to disseminate warnings and influence behavior, taking cognizance of traditional practices, norms and beliefs that exist in the project sites. Stakeholder consultations will be conducted to get feedback from at-risk communities, particularly on the last mile messaging and communication aspects of the MH-IBF-EWS, including the business sector that participate in the weather enterprise, such as private cellular companies, TV and radio that deliver public safety information services

3.4. Develop early action protocols applicable to project sites including shock-responsive social protection

This activity will mainly focus on the implementation of the forecast-based financing and early action (FbA) component of the project in the four project sites. FbA is an innovative approach linking early warning to pre-determined early actions and the appropriate financing to do those actions. A vulnerability and risk assessment will be undertaken to understand the food security and nutrition status of the project sites to support the development of early actions at the community level to protect lives and livelihoods. This action will focus on initiating a Comprehensive Food Security and Vulnerability Assessment (CFSVA) to determine the baseline situation in the target areas. This assessment will determine how food insecure communities in the target areas make use of early warning, climate and forecast information, which institutions and agencies they trust, and how messaging should be tailored to build adaptive capacity. This assessment will serve as the starting point for designing the programming for forecast-based financing at the local level, as it will help determine priority needs of vulnerable people and the appropriate early actions that should be adopted. Identification of measures that will make social protection schemes more shock-responsive will also be conducted in consultation with concerned government agencies, private sector such as the insurance industry, and vulnerable groups.

Early action protocols will be developed for each hazard at certain impact levels relevant to the project site. Triggers that will activate the agreed FbA protocols will also be determined in collaboration with the vulnerable communities, local decision makers, private sector engaged in media, communication and transportation services and local NGOs on the ground. This will focus on convening experts for community consultations to determine the appropriate triggers and thresholds to initiate early actions in the four project sites and developing early action protocols. The impact-based forecasts developed will be presented at the local level and triggers for early actions to be taken prior a disaster will be developed to bridge the gap between the time that a forecast is released to emergency response. After these early action protocols are developed in the project sites, these will be tested through functional simulations and drills, and further refined following testing.

Harmonization of existing early action protocols and triggers such as the WFP FbF manual, LISTO manual and other existing SOPs and operational plans at both national and local levels will also be undertaken. This willl focus on determining an entry point for the early action protocols developed at the local level to be fully integrated and adopted into local planning and budget, and harmonizing them with the existing protocols in place for emergency response.

The LGUs in the project sites and Co-executing Entities such as DILG and WFP will conduct the review and consultations on existing local resilience plans, i.e. LDRRMP, LCCAP, disaster preparedness plan, contingency plan, emergency operations plan and other existing protocols to integrate a window of early action into existing policies and practices at both local and national levels. This will ensure that early action protocols (EAPs) developed for the project sites are adopted into local planning and the institutionalization of FbA approach at the national level and that resources will be allocated for their implementation.

Functional simulations and drills to test and refine the early action protocols for each hazard in the project sites will be regularly conducted. These actions will focus on convening experts for community consultations to determine the appropriate triggers and thresholds to initiate early actions in the four target areas. The impact-based forecasts developed will be presented at the local level and triggers for early actions to be taken prior a disaster will be developed to bridge the gap between the time that a forecast is released to emergency relief. After these early action protocols are developed in the target areas, these will be tested through functional simulations and drills, and further refined following testing.

Climate-resilient livelihood options will be identified in the project sites in collaboration with stakeholders such as civil society, academe and private sector to promote long-term adaptation efforts in the project sites. Based on the CFSVA, consultations and capacity strengthening of the four project areas, early actions to protect climate-resilient livelihoods (i.e. early harvesting, adjustment of planting, support to food baskets/non-food items, cash-based transfers, alternative livelihood support, livestock support) will be identified and integrated into the early action protocols. This activity will leverage on the FbA initiatives of WFP in the Philippines implemented since 2015 in 10 provinces.

3.5. Develop knowledge products and information, education and communication (IEC) materials on MH-IBF-EWS including FbA and conduct advocacy and outreach starting in project sites

This activity will focus on developing products and materials to inform and educate all end-users of MH-IBF-EWS starting in the project sites to support coordination and dissemination in the project sites. Under this activity, knowledge products, e.g. e.g. manual for forecasters, developing EAPs for FbA, as well as IEC materials, e.g. leaflets, posters, videos on MH-IBF-EWS in the vernacular language, educational materials on indigenous knowledge and practices vis-a-vis early warning system information in their locality will be developed in consultation with the respective end-users. Testing and evaluation of IEC materials targeting end-users in the project sites will be conducted to evaluate their effectiveness and consequently update or enhance them as needed.

3.6 Expanding the use of MH-IBF-EWS nationwide using scenarios

The approach to expand and roll-out the MH-IBF-EWS framework from the four project sites is by including the surrounding areas, i.e. all cities and municipalities in the province where the project sites are located as well as civil society, academe and business sectors operating in the province to all advocacy and outreach activities of the project. As mentioned in Output 3.2 above, the mayors and LDDRMOs of the cities/municipalities in the concerned provinces as well as their governors and PDDRMOs will be invited to participate in all capacity building activities to be implemented in the project sites.

Using the scenario approach, the promotion of MH-IBF-EWS in the whole country will be undertaken. Knowledge products and IEC materials will be disseminated to LGUs in the country. Dissemination and outreach activities will take advantage of regular advocacy activities of the government, for instance, annual resilience caravans of OCD, PAGASA Typhoon and Flood Awareness Week, National Science and Technology Week, WMO Day, Monthly Climate Forum, among others; use of traditional media such as local radio programs and social media such as Twitter and Facebook and other communication channels.
Conduct of peer-to-peer learning workshops on FbA to share and disseminate best practices, lessons learned and experiences by stakeholders. The LGUs in project sites, DILG and WFP will conduct multistakeholders forum on FbA and convene technical workshops to share evidence-based best practices and challenges.

35. **Output 4. Mainstreamed climate risk information and MH-IBF-EWS in development policy and planning, investment programming and resilience planning at national and local levels and institutionalized people-centered MH-IBF-EWS in the Philippines.**

Mainstreaming of impact-based early warning systems as a climate risk management strategy in development planning processes at national and local levels of governments will be undertaken. Mainstreaming climate impact forecast and risk information into sectoral development planning processes and effective integration of EWS with institutional and policy-making processes can enhance the sustainability of development programs and projects and decrease the vulnerability of communities from climate-related risks. Integrating MH-IBF-EWS in investment programming is necessary to ensure that the necessary resources for related activities and equipment (e.g. maintenance costs of AWS) will be allocated. This is also in support of the Joint Memorandum Circular 2015-01 which legally requires LGUs to tag and track their climate change expenditures in their Annual Investment Program. Specifically, LGUs must identify, prioritize and tag climate change programs, activities and projects and report climate change expenditures.

This output aims to effect a more coherent, risk and evidence-based development polices and plans, investment programs at the national and local levels and facilitate the institutionalization of MH-IBF-EWS and climate risk information in local policies, plans and budgets.

This output will also involve the expansion of mutually beneficial multi-stakeholder partnerships to mobilize and share knowledge, expertise, technologies and financial resources to support the implementation of MH-IBF-EWS in the country. The private sector, particularly business entities actively involved in providing public safety services such as communication services, media, transportation services, etc. in varying extent in the full value chain of activities, from observations to data acquisition tools and technologies, information generation and processing technologies, to product dissemination and services, will be recognized as a set of stakeholders in end-to-end early warning service delivery supporting the implementation of MH-IBF-EWS.

4.1 Enhance existing manuals and guidebooks on integrating MH-IBF-EWS and FbA in national and local resilience planning processes

A review of all existing manuals, guidebooks, plans and SOPs such as the NDDRM Framework and Plan, National Disaster Preparedness Plan, National Disaster Response Plan, NCCAP, pre-disaster risk assessment, incident command system, service continuity plans, etc. will be conducted. This output will then enhance and harmonize existing manuals and guidebooks on integrating MH-IBF-EWS and FbA in national and local resilience planning processes. The output will ensure that at all levels, the manuals/guidebooks produced on MH-IBF-EWS will help guide the mainstreaming in national and local plans, i.e.N/LDRRMP, national/local climate change action plan (N/LCCAP), local disaster preparedness and response plans, contingency plans and other local resilience plans.[48] The manuals/guidebooks will spell out coordination mechanisms and structures among national and local levels to efficiently implement the impact-based EWS. This will contribute to make climate risk management in the country more proactive and inclusive.

4.2 Strengthen national inter-agency operational coordination mechanisms at the national level to implement MH-IBF-EWS

Underpinning these policy and planning enhancements are the institutional strengthening of the inter-agency operational coordination mechanisms at the national level. This output will strengthen and ensure seamless interoperability coordination mechanism amongst DOST-PAGASA, DENR-MGB, OCD and DILG and other key national/local agencies as coordinated by the NDRRMC by creating an inter-agency committee on MH-IBF-EWS headed by DILG and DOST-PAGASA with OCD as secretariat. This inter-agency operational body will include representatives from the private sector, academe and civil society engaged in end-to-end early warning systems. Each collaborating agency will enhance/develop their own respective early warning SOPs mainstreamed with the MH-IBF-EWS to fully realize the operational readiness to address the hazards.

Strong inter-agency partnership along with close engagement of stakeholders and end-users supported by policy declaration with robust participation of the communities will be necessary in every step of the EWS process. From co-developing the risk-matrix, impact and response tables and early warning messages with active involvement of all key players in determining effective dissemination channels to agreeing on priority early actions that at-risk communities will undertake upon receiving the alerts in advance of the event. In order to effectively implement and deliver the MH-IBF-EWS Project, regular coordination meetings and communication (monthly progress reporting/tracking, and quarterly impact assessment) to include task and commitment monitoring among members of the interagency body will be conducted to cultivate a common understanding of all aspects of MH-IBF-EWS. Transparency in decision making and information sharing will be practiced.

4.3 Develop multi-stakeholder partnerships at the national and local levels for FbA and social protection

Strengthening adaptive capacities and resilience from the national level down to the community level requires collaborative partnerships across all levels of government, civil society, academe, private sector, and other stakeholders. A government-led national technical working group (TWG) on FbA will be formed by building on the existing TWG on FbF chaired by WFP, PRC and FAO. A Memorandum of Agreement (MOA) to institutionalize FbA among the different actors and national government will be drafted and signed by relevant agencies, similar to the MOA signed between the Department of Social Welfare and Development (DSWD) and WFP.

A Task Force or Local Inter-Agency Committee will be organized at the LGU level supported by a policy declaration (i.e. SB Resolution or an Executive Order) in the project sites. The task force or local committee will strengthen linkages with at-risk communities to ensure close coordination and smooth implementation of early actions during the lead time.

36. The theory of change (Annex 2a) illustrates how the outputs and activities of the project contribute to the attainment of long-term objectives and how the resulting project impacts can be sustained, replicated and scaled up. The detailed project-level Logframe is provided as Table 12 in Annex 2a.

37. An environmental and social assessment has been conducted for the project in order to identify and evaluate the project's potential environmental and social impacts. To ensure that impacts are managed effectively and in a manner consistent with the Environmental and Social Safeguards of the GCF, preventive and mitigating

[48] In this Funding Proposal, all these related local plans are referred to as **local resilience plans**. See footnote 10.

measures has been prepared so that environmental and social considerations are reflected throughout the project stages.

38. As evaluated in the assessment, the project is expected to have minimal environmental and social impacts and is more likely to generate beneficial impacts. It is expected that potential environmental and social impacts would emanate only from structural interventions such as installation of EWS including Automatic Weather Stations (AWSs) and other hydro-meteorological equipment such as water level, tide gauges, and landslide monitoring devices. The project will ensure that all equipment to be purchased meets international environmental, safety and technical standards.

39. AWSs are typically installed within local government owned properties such as state universities, municipalities, barangay, etc. Since obstructions such as trees will affect the readings of the AWSs, increase in removal of vegetation is likely to occur. During project design phase, the selected project site will be carefully assessed and will be situated away from the influence of obstructions such as trees. Moreover, AWSs will be installed in all of the proposed project sites following the standard specification requirements of the World Meteorological Organization (WMO) of a 10-meter height over open terrain. If removal of vegetation is deemed necessary, the removal will only be limited to the required number of trees. The project will also ensure that relevant permitting requirements will be secured and terms and conditions will be followed.

40. Other significant negative environmental and social impacts which would potentially occur from the installation works of AWSs include noise pollution from machinery and equipment, increase in generation of solid wastes, and increase in dust emissions as a result of excavation and civil works during the installation of the AWSs especially in new sites. These impacts will affect, albeit temporarily, occupational health and safety of workers to be involved during construction works and surrounding locality in close proximity to the selected local government owned properties. In order to reduce potential impacts of these hazards, the project shall ensure that proper personal protective equipment (PPE) is worn by the workers during equipment installation.

41. The project will not require land acquisition and/or resettlement of local population. Should the project need to install in areas within the vicinity of physical cultural properties, protected areas or natural monuments, appropriate steps will be taken to ensure minimal impacts in these special zones. Considering the indigenous populations, specifically the Mansaka and Mandaya tribes in New Bataan, they shall be informed of the project activities and consulted as the project progresses. Feedback from the IPs will also be useful to improve the project's responsiveness.

42. After the assessment and considering all project activities, the project has been recommended as having low or minimal adverse environmental impact. Moreover, the project shall be beneficial to the communities and stakeholders involved. Thus, the proposed project is classified as Category C or will not have significant adverse environmental and social impacts.

43. LANDBANK aims to address stakeholders' complaints related to issues where programmes/projects supported by the GCF have failed to respect E&S safeguards, as well as disputes arising from deviations in expected performance of GCF programmes/projects. Through GRM, people or communities adversely affected by the programme/project are assured of being heard, assisted, and provided with appropriate remedy on complaints/problems raised in a timely manner.

44. The GRM is anchored on the LANDBANK EO No. 092, Series of 2016 – Guidelines on LANDBANK's Customer Assistance Management, which cover the policies and procedures in handling customer inquiries, requests, or complaints (i.e., issues, concerns).

45. To supplement the Bank's guidelines on Customer Assistance Management to facilitate application with the GCF programmes/projects, the following additional guidelines are issued:

    1) The LANDBANK's Environmental Program & Management Department (EPMD) is the unit responsible for stakeholder inquiries, requests, and complaints related to GCF-supported programmes/projects.

    2) Where the EE for a given GCF programme/project is an organization or agency other than LANDBANK, the EE concerned is required to set up its own GRM. The Subsidiary Agreement executed between LANDBANK and the EE shall include provisions for implementation by the EE of its own GRM.

3) Relevant contact details and information for forwarding inquiries, requests, or complaints from stakeholders is included in the LANDBANK website, as follows:

Environmental Program & Management Department
27F LANDBANK Plaza
1598 M.H. Del Pilar corner Dr. J. Quintos Sts.
Malate, Manila, Philippines
Email: lbp.epmd@mail.landbank.com

Stakeholders concerned shall be informed of the GRM system and procedures during the Stakeholders' consultation activities conducted for GCF programmes/projects.

B.3. Implementation / institutional arrangements (max. 750 words)

46. LANDBANK as the accredited entity will carry out this project and apply the experiences it has gained in implementing various Official Development Assistance (ODA) projects (loans or grants) from multilateral and bilateral funding institutions. This includes applying the results management, monitoring and verification concepts and approaches learned as may be applicable to this project.

47. In line with the Accreditation Master Agreement that sets forth, among others, the general terms and conditions between the Parties in connection with Funded Activity, the Land Bank of the Philippines will enter into Funded Activity Agreement with the Green Climate Fund. Furthermore, the Accredited Entity will carry out the project through signing a Subsidiary Agreement (SA) with DOST-PAGASA as the lead EE, as well as with the Co-Executing Entities (DENR-MGB, DILG, OCD, WFP, LGUs).

48. LANDBANK will be responsible for overseeing, supervising, managing and monitoring the over-all GCF-approved projects and programs to achieve specified results with guidance from a Project Operations Manual, which LANDBANK and DOST-PAGASA would prepare. A GCF Program Team shall be established by LANDBANK which shall conduct supervisory mission twice a year during the implementation period to ensure that the Project is being implemented in accordance with the legal agreements that the Bank have entered into with the GCF. In addition, the LANDBANK shall provide constant advice and guidance to the entities that will implement the project in terms of technical aspects, fiduciary requirements, environmental & social aspects, and monitoring & evaluation.

49. DOST-PAGASA will be the Executing Entity and will serve as the Project's lead "Implementing Agency", Partner agencies like DILG, DENR-MGB, OCD, concerned project site LGU and WFP which will implement specific project activities will be called "Co-executing Entities". The Co-executing Entities will be allowed to procure and disburse funds under the supervision of the EE. The Co-executing Entities' work & financial plan, procurement plan, M&E plan, among others, will be reviewed and monitored by the EE to ensure their alignment with the Project's LogFrame and proper/effective implementation. Hence, LANDBANK will sign a Subsidiary Agreement with DOST-PAGASA as the lead EE, and with the Co-executing Entities.

50. While the overall execution/implementation of project will rest upon the DOST-PAGASA as an executing entity, outputs and activities/sub-activities will be implemented by Co-executing Entities. Project implementation structure is presented below. The project will engage the following organizations in achieving project outputs.

51. DOST-PAGASA – Executing Entity, implements activities related to enhancement of observation network in selected target areas; development of probabilistic hazard maps and probabilistic forecast using numerical weather prediction and modelling; risk matrix for impact-based forecasting and warning with the involvement of stakeholders, integrated knowledge system and decision support platform for MH-IBF-EWS; and conduct of risk analysis and assessment incorporating vulnerability exposure and hazard, among others.

52. DENR-MGB – Co-Executing Entity, responsible for generation of landslide hazard maps and establishing threshold values for landslide. Being a core member of the multi-agency Pre-Disaster Risk Assessment (PDRA) group, provides valuable inputs in the preparedness efforts of the NDRRMC whenever there are forthcoming hydrometeorological and other hazard events threatening the country. The information provided by DENR-MGB is utilized by the DILG, LGUs, Department of Social Work and Development and other national

government agencies with disaster preparedness and response mandates in making the necessary preparations appropriate for various levels of risks.

53. DILG – Co-Executing Entity, responsible for advocacy, outreach and public awareness on MH-IBF-EWS, capacity building of local government units to effectively deliver climate risk information and training of communities and local first-responders, and update/establish disaster preparedness and response protocols using impact-based early warning system.

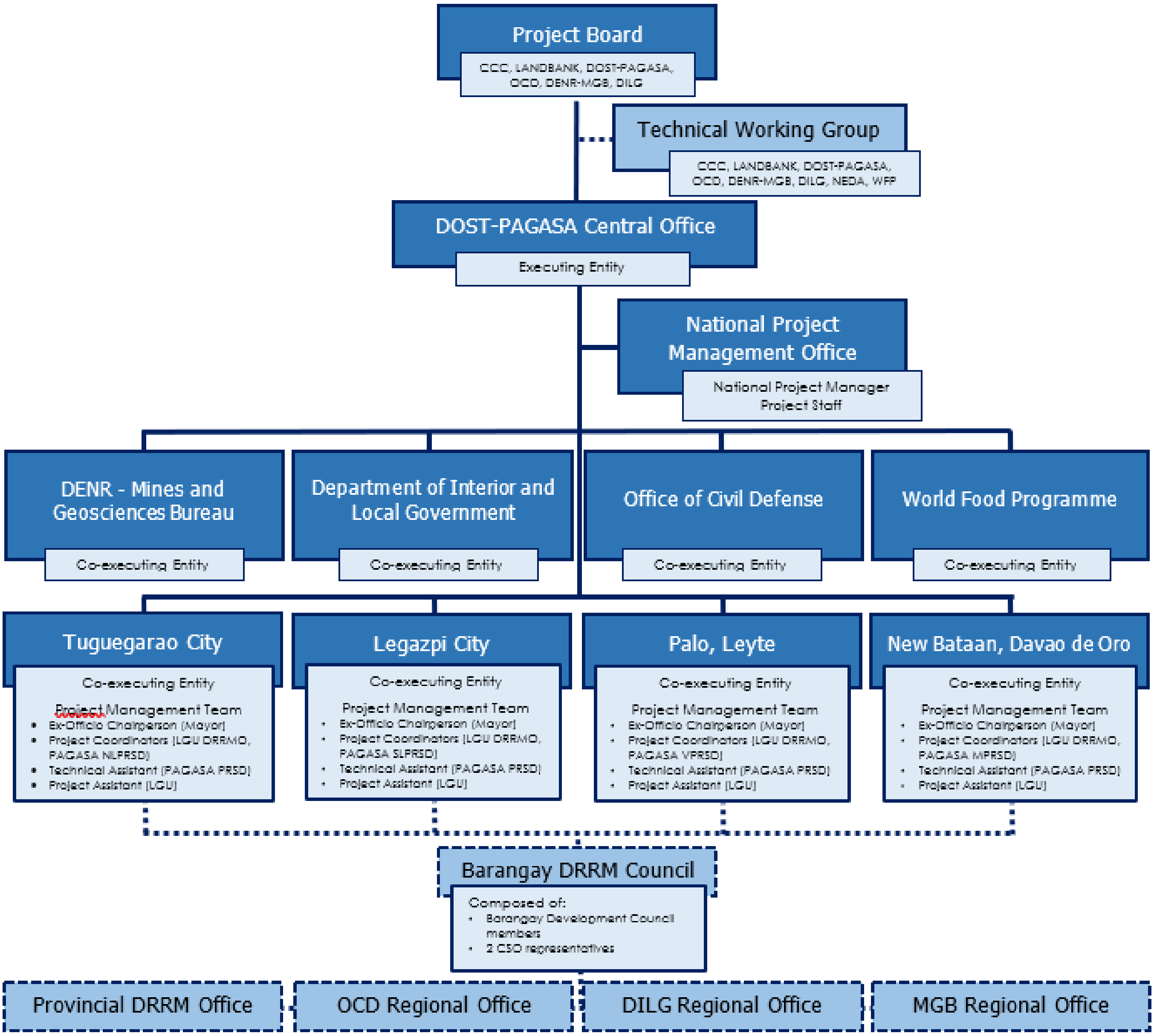
54. OCD –Co-Executing Entity, as implementing arm of the National Disaster Risk Reduction and Management Council (NDRRMC), OCD facilitates inter-agency coordination, mobilize resources for disaster preparedness and response and information management including communications at the national and regional levels. As such, it will be responsible for developing and ensuring the implementation of national standards, protocols and SOPs in coordination with key government agency members of the NDRRMC, including impact-based early warning systems and FbA policies to be developed under this proposal.

55. WFP – Co-Executing Entity, who will lead in activities related to FbA and shock-responsive social protection, including development of index-based triggers and SOPs aligned with impact-based forecasting and warning system. WFP is the leading humanitarian organization in saving lives and changing lives, delivering food assistance in emergencies and working with communities to improve nutrition and build resilience. WFP is governed by a 36-member Executive Board. It works closely with its two Rome-based sister organizations, the Food and Agriculture Organization and the International Fund for Agricultural Development. WFP partners with more than 1,000 national and international NGOs to provide food assistance and tackle the underlying causes of hunger.

56. Four LGUs – Co-Executing Entities, responsible for leading all activities in the project sites, such as building the exposure database with population and socio-economic variable, housing and building data and for gathering data in the field, identifying forecast-based actions and financing mechanisms, adopting early action protocols (EAPs), implementing the EAPs and identified alternative resilient livelihood options, integrating MH-IBF-EWS and FbA in their respective local resilience plans, among others. As project beneficiaries, they will be capacitated to become more proactive in disaster preparedness and response to implement early actions and resource mobilization such as pre-emptive evacuation, prepositioning of assets and resources, etc. The Barangay DRRM (BDRRM) Councils of each LGU will be engaged and consulted in all activities at the project site level and participate in capacity building workshops, etc. The BDRRM Council is composed of the Barangay Development Council members and at least 2 CSO representatives from existing and active people's organizations representing the most vulnerable and marginalized groups in the barangay as mandated by the Local Government Code.

57. A Project Board consisting of DOST-PAGASA, CCC, LANDBANK, OCD, DENR-MGB and DILG will be set up at the national level to provide project oversight and discuss strategic concerns. The Project Board, with the assistance of the Technical Working Group (TWG), will review and approve the plans of DOST-PAGASA and the Co-executing Entities as well as oversee their performance. The TWG composed of the members of the Project Board together with NEDA, and World Food Programme (WFP) will meet regularly to discuss technical and operational issues and guide project implementation.[49]

[49] DOST-PAGASA has coordinated with WMO requesting their involvement in the project. WMO has agreed to provide technical expertise. The MH-IBF-EWS Project Team will consult with WMO at critical points during project implementation. DOST-PAGASA is a member of the World Meteorological Organization (WMO). WMO provides yearly training on IBF through the Severe Weather Forecasting Development Project



Note: The BDRRM Council is composed of the Barangay Development Council members and at least 2 CSO representatives from existing and active people's organizations representing the most vulnerable and marginalized groups in the barangay as mandated by the Local Government Code.

A National Project Management Office will be established within DOST-PAGASA manned by a project-hired Project Manager and five (5) staff who will be under the supervision of the DOST-PAGASA Administrator. Program Management Office (PMO) and a Project Management Team (PMT) will also be established in each of the four project sites. A project site PMT will be composed of DOST-PAGASA-PRSD, LGU DRRMO, and two (2) project-hired staff, in coordination with the local offices of DILG, MGB and OCD, will be established to manage the implementation at the project site. The Mayor will serve as ex-officio head of the PMT in his/her area of jurisdiction.

C. FINANCING INFORMATION

C.1. Total financing

(a) Requested GCF funding (i + ii + iii + iv + v + vi)		9,999,042.27		USD ($)	
GCF Financial Instrument		**Amount**	**Currency**	**Tenor**	**Pricing**
(i)	Senior loans	0	Options	Enter years	Enter %
(ii)	Subordinated loans	0	Options	Enter years	Enter %
(iii)	Equity	0	Options		Enter % equity return
(iv)	Guarantees	0	Options	Enter years	Enter %
(v)	Reimbursable grants	0	Options		
(vi)	Grants	9,999,042.27	USD ($)		

(b) Co-financing information	**Total amount**			**Currency**		
	10,192,307.69			USD ($)		
Name of institution	**Financial instrument**	**Amount**	**Currency**	**Tenor**	**Pricing**	**Seniority**
DOST-PAGASA	In kind	10,192,307.69	USD ($)	Enter years	Enter%	Options
Click here to enter text.	Options	Enter amount	Options	Enter years	Enter%	Options
Click here to enter text.	Options	Enter amount	Options	Enter years	Enter%	Options
Click here to enter text.	Options	Enter amount	Options	Enter years	Enter%	Options
(c) Total investment (c) = (a)+(b)	**Amount**			**Currency**		
	20,191,349.96			USD ($)		

(d) Co-financing ratio (d) = (b)/(a)	102 percent
(e) Other financing arrangements for the project/programme (max ½ page)	Co-financing are budgetary allocations from the Government of the Philippines to DOST-PAGASA specifically to finance the purchase of equipment and software under Outputs 1 & 2. Technically, said co-financing will be provided to the project in-kind in the form of equipment and software.

C.2. Financing by component

Please provide an estimate of the cost per component (as outlined in Section B.2. above) and disaggregate by sources of financing.

OUTPUT	**Indicative cost (USD)**	**GCF financing**		**Co-financing**		
		Amount (USD)	**Financial Instrument**	**Amount (USD)**	**Financial Instrument**	**Name of Institutions**
Science-based multi-hazard weather and climate risk information is generated	14,087,084.58	3,894,776.88	Grant	10,192,307.69	In kind	DOST-PAGASA
Established multi-hazard impact-based forecasting and early warning system (MH-IBF-EWS) supported by a knowledge and	3,120,000.00	3,120,000.00	Grant	-		

decision support system.						
Improved national and local capacities in implementing a people-centered MH-IBF-EWS and forecast-based early actions (FbA).	1,939,692.31	1,939,692.31	Grant	-		
Mainstreamed climate risk information and MH-IBF-EWS in development policy and planning, investment programming and resilience planning at national and local levels and institutionalized people-centered MH-IBF-EWS in the Philippines.	511,207.69	511,207.69	Grant	-		
Project Management Cost	533,365.38	533,365.38	Grant	-		
TOTAL	**20,191,349.96**	9,999,042.27		10,192,307.69		

Detailed information on the costs of the activities are provided in Annex 3-Budget.

C.3. Justification for GCF funding request (max. 500 words)

58. The Government of the Philippines is committed to the improvement of its forecasting and climate information systems. However, budget constraints due to large investments in poverty alleviation and infrastructure limit the resources available for other activities. As disasters strike more frequently, the cost of disaster response and mitigation also increases. But the national budget continues to lag behind, unable to meet the country's many competing needs. The composition of government expenditures, particularly the share of non-mandatory expenses, leaves little room for flexibility to allow a bigger impact on disaster spending. In the case of LGUs, they have varying disaster-related expenditure demands and revenue-raising capacities which are both affected by the incidence and severity of calamities that strike them.

59. While it cannot be denied that there have been significant innovations in the area of disaster preparedness and considerable amount of funds spent for the said phase, its various elements are continuously being challenged. Community participation and decentralization is ensured through the delegation of authority and resources to local levels, but existing financial constraints continue to affect the capacity of certain LGUs for effective disaster preparedness and response.

60. GCF Funding requirement. Currently, DOST-PAGASA is upgrading its physical resources and operational techniques through acquisition and development of state-of-the-art instruments, equipment, facilities, and systems which are needed in the development of impact-based forecasting and warning. GCF support is critical to fully implement a MH-IBF-EWS and enable additional investments that allow scaling up of existing efforts for transformative reach and impact across the country. Improving climate risk management systems and enhancing capacities to establish and use impact-based forecasting and early warning are a key priority of the country. According to WMO, the total cost of DOST-PAGASA's improvement for to reach international standards as a warning agency is USD 32.7 Million over a five-year period.[50] The government is constrained by limited financial and human resources among the relevant national government agencies and partners.

[50] World Bank, UNISDR, PAGASA, GFDRR and WMO. 2010. *Strengthening of Hydrometeorological Service of Southeast Asia: Country Assessment Report for the Philippines*.

Without GCF support, it would take considerable time and resources before the institution of a nationwide people-centered MH-IBF-EWS.

61. With GCF assistance, it is envisaged that financial, technical capacity, and physical investment gaps in making MH-IBF-EWS a reality will be addressed at full-scale. International cooperation is always needed for such undertakings and so existing bilateral and multi-lateral partnerships and collaboration will be continued and leveraged. Through a multi-stakeholder approach and a more intentional approach of mainstreaming climate risk management policy making, planning and investment programming, the project will uphold transparency of climate information and accountability among concerned public and private actors in ensuring that vulnerability and risks of communities, livelihoods, and infrastructure are reduced.

62. Alternative funding options. There are limited funding options for DOST-PAGASA to undertake the extensive investments outlined under the Modernization Plan. GCF involvement will be critical for DOST-PAGASA to adequately embark on impact-based forecasting and early warning service as a measure to provide complementarity to the initiatives it has undertaken. In the context of other countries shifting to impact-based forecasting and early warning, this GCF investment can be deemed as contribution to a global public good. The provision of accurate, timely and actionable warnings will also facilitate business sector activities and investments and may encourage the private sector such as the insurance and reinsurance industry to provide more appropriate insurance products to households, local business, agriculture sector, and public sector.

63. Level of concessionality from GCF. As the project is focused on delivering public goods, the Government of the Philippines, through DOST-PAGASA and LANDBANK, is requesting 100% concessionality (grant funding) from GCF. Climate shocks represent a large economic and financial burden outstripping what the national public finance can manage. Moreover, the project will not yield any direct profit to the Government of the Philippines or DOST-PAGASA as it is designed to provide public services in the form of accurate and timely weather forecasts and climate services.

C.4. Exit strategy and sustainability (max. 250 words)

64. By end of the GCF project, DOST-PAGASA, will be institutionally, technically, and technologically equipped and trained to maintain the modelling, forecasting and early warning systems and scale-up MH-IBF-EWS countrywide. The development of MH-IBF-EWS is part of the priorities of DOST-PAGASA's Strategic Plan (2018-2022) and thus will be fully integrated into the budget of the agency, therefore operation and maintenance costs of the meteorological and hydrological monitoring equipment will be its responsibility. Annually, DOST-PAGASA submits its budget proposal to the Department of Budget and Management to cover expenses for its various activities such as General Administration and Support, Support to Operations, and Operations, i.e. Weather and Climate Monitoring, Forecasting and Warning; Flood Monitoring, Forecasting and Warning and Research and Development on Atmospheric, Geophysical and Astronomical and Allied Sciences. Under the General Appropriations Act of 2019, USD 3,503,608.00 (Php 178,375,000.00) has been allocated for these activities. The operation and maintenance, installation, construction and repair expenses of DOST-PAGASA facilities are charged against the "Support to Operations Program."

65. In addition, DOST-PAGASA typically installs in weather observing and monitoring equipment in its existing 59 weather observing stations (e.g. synoptic, agromet, etc.) located strategically across the country. This is to ensure the security of the facilities and equipment to ensure the continuous operations of these facilities. Automatic Weather Stations (AWS) will be procured and installed during the first year of the project implementation. The estimated total unit cost is P1.4M, including installation works. The land requirement for AWS and tide station are 36 sq. m. and 9 sq.m., respectively. A typical synoptic station has an lot area of at least 500sq.m AWSs are also installed in local government owned properties such as state universities, municipalities, barangay, etc. A Memorandum of Agreement or a Deed of Usufruct in this case will be executed between DOST-PAGASA and the concerned LGU to ensure the security and continuous operations of the facilities. A Memorandum of Agreement (MOA) will also be signed between the DOST-PAGASA and the concerned barangay/s stipulating the barangay's agreement to keep watch of the installed equipment. The communities then have a sense of ownership over the system. DOST-PAGASA will still regularly check and maintain the system.DOST-PAGASA has learned lessons when it comes to protecting its investments in equipment and facilities and will bring this forward to this GCF project to ensure project sustainability. One significant lesson is that local government units in past projects were not able to maintain and keep the equipment operational due to the fast turnover of its trained personnel and for other reasons, when procured equipment were turned over completely to them. Hence, DOST-PAGASA has made it its policy that all procured equipment will be operated and maintained by its Regional Services Divisions. All equipment installed and procured through this GCF project will be considered as properties of DOST-PAGASA, become a part of its

observing network and will therefore be included in its Operations and Maintenance Plan and yearly budget allocation.Further, through its Engineering and Techniques Division (ETSD), DOST-PAGASA monitors the operations and conducts regular maintenance of all equipment and facilities it has installed around the country. ETSD engineers and technicians conducts scheduled inspections and repairs, whenever necessary. Continuous trainings of engineers and technicians are likewise undertaken to ensure that they have the necessary skills and knowledge for this purpose. Moreover, DOST-PAGASA includes the quality of after-sales services of the supplier during the procurement process with the preference of higher level and quality of after-sales services as part of its selection criteria.

66. The strengthened stakeholder partnership and coordination developed under Output 4 will provide the political support to allocate necessary resources by government to sustain this effort (e.g. operation and maintenance costs). Enhancing local ownership by LGUs will be done through a memorandum of agreement. The LGUs will provide a safe location and security for the selected sites where early warning equipment will be installed by the project and be responsible for the maintenance of these equipment.

67. The improved capacity of LGUs and communities under Output 4 to use climate risk information in their planning processes and practical early responses to impending extreme weather events will strengthen the potential of generated knowledge and its application to be sustained. The project includes a strong focus on community engagement, training and “Last Mile” communication solutions in order to elevate understanding of climate risks and achieve sustainable change in behaviour among local communities. Establishment and operationalization of national and local coordination mechanisms and SOPs will ensure that all stakeholders know what to do, when and how. Participation of other partners (e.g. NGOs, private sector, and academic institutions) will further promote the sustainability of this project into the long-term. The project will also pave the way to a greater involvement of private sector in the delivery of climate information products and services, risk transfer schemes and risk reduction.

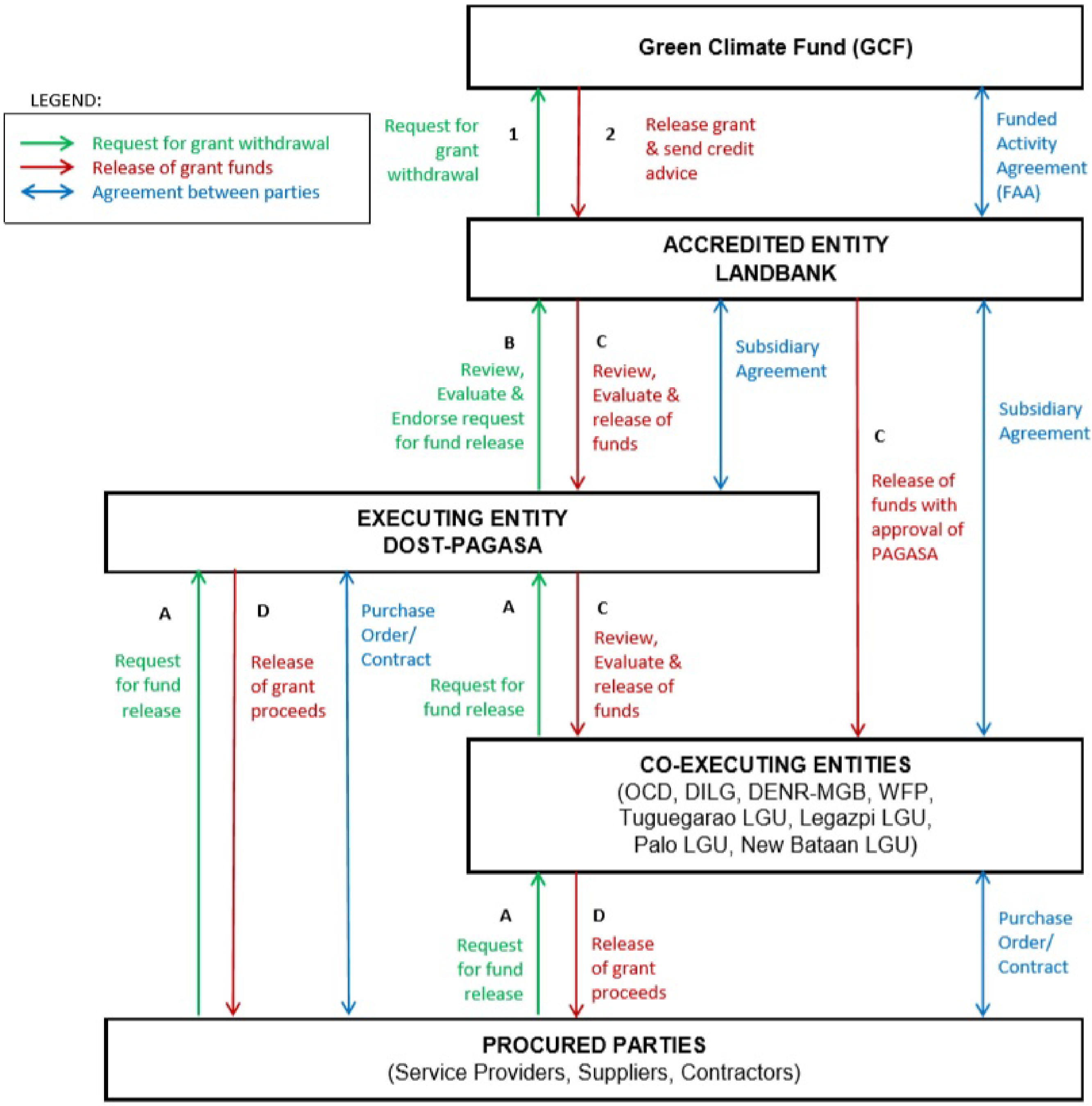
68. Beyond project life, DOST-PAGASA will continue to provide impact-based forecasts and warnings nationwide. At the local scale, e.g. municipal/city, provinces, DOST-PAGASA and its Co-executing Entities will continue to provide assistance to other municipalities/cities surrounding the project sites and provinces where they belong in order to develop local-scale risk matrix with impact tables and response tables with the involvement of stakeholders. The institutionalization mechanisms of DOST-PAGASA by covering operating and maintenance costs guarantees the long-term sustainability beyond project completion.

C.5. Financial management/procurement (max. 300 words)

69. Fund disbursement will be from the GCF to LANDBANK. The project funds will be deposited in a designated account managed by LANDBANK. It is envisaged that a Subsidiary Agreement (SA) shall be signed between LANDBANK and DOST-PAGASA as the lead EE, as well as with the Co-executing Entities (DENR-MGB, DILG, OCD, WFP, LGUs). As the main grant recipient, DOST-PAGASA would ensure that the terms and conditions outlined in the SA are passed on to the Co-executing Entities as grant recipient and that payment for eligible expenditure will be released by LANDBANK to the EE and/or Co-executing Entities in order to enhance accountability and oversight. LANDBANK will not have the mandate to release/effect payment without written directive and approval from the EE (DOST-PAGASA). The fund release/payment request will strictly follow the approved Work & Financial Plan and/or Procurement Plan. Upon receipt of the request for fund release/payment from DOST-PAGASA, LANDBANK will review to ensure that requested transaction is within the budgeting parameters and aligned with the approved Work & Financial Plan and Procurement Plan. The release/utilization of funds will be monitored through an internal control framework, which depicts the fund transfer and reporting channels; it shows that funds received by the project account are then channeled through the government structure – national, regional and local – and reported back through the same channel. Succeeding releases shall be subject to submission of liquidation reports. The channel for fund disbursement and financial reporting arrangement is illustrated in the following diagram on the next page.

70. In the purchase of goods, such as equipment and instruments, as well as consulting and non-consulting services, procurement procedures will follow the Philippine Republic Act 9184, entitled “An Act Providing for the Modernization, Standardizationion and Regulation of the Procurement Activities of the Government and for other Purposes,” otherwise known as Government Procurement Reform Act. In addition, LANDBANK will

conduct review the procurement plans of the EE and Co-EEs, and conduct procurement review on a semestral basis.



D. LOGIC FRAMEWORK AND MONITORING, REPORTING AND EVALUATION

This section refers to the project/programme's logic framework in accordance with the GCF's Performance Measurement Framework under the Results Management Framework to which the project/programme contributes as a whole, including in respect of any co-financing. This is different from the project/programme-level log frame(as there may be other impact measures for example that go beyond those defined by the GCF).

A project-level logical framework, with specific indicators, baselines and targets, means of verification and assumptions should be provided as part of Annex 2.

D.1. Paradigm shift objectives

Increased climate-resilient sustainable development	This project will address the urgent need for a more proactive and inclusive climate risk management in the Philippines anchored on a people-centered multi-hazard impact-based forecasting and early warning systems (MH-IBF-EWS) for flood, landslide, severe wind and storm surge. A MH-IBF-EWS that is people-centered will increase the availability of, access to, and understanding of early warning, enabling end-users, particularly in the last mile, to reduce their exposure to climate risks, and strengthen their absorptive and adaptive capacities to better manage or adjust to impacts brought about by climate shocks and climate change, and increase capacities to develop long-term climate risk reduction and adaptation measures. The project will thus catalyze a paradigm shift from the traditional weather forecasts to multi-hazard impact-based forecasting and early warning. The project innovation includes combining best available science and local knowledge on probabilistic hazard mapping, modelling and forecasting and risk assessment. Capacity development on climate risk management, including preparedness, forecast-based early actions and financing and response will ensure that impact-based early warning services will be usable down to the last mile. Probabilistic risk assessment, mapping, and technologies will be developed to provide risk information that will inform development policies, investment programs, and resilience plans at national and local levels. The project will enable timely and actionable warning information to end-users, particularly the communities at-risk. By improving people's understanding of potential impacts of extreme hydrometeorological events, communities can take early mitigating actions and minimize or prevent adverse impacts on lives, livelihoods, property and economy. Improving the EWS through people's meaningful participation and communication, dissemination and information system that supports decision-making and planning by all end-users will redound to a reduction of loss of life and assets, mitigation of anticipated negative impacts of climate-induced hazards before, during and after extreme weather events, and development of a diverse range of proactive and inclusive climate risk management and adaptation strategies.

D.2. Impacts measured by GCF indicators

Expected Result	Indicator	Means of Verification (MoV)	Baseline	Target		Assumption
				Mid-term (if applicable)	Final	

Core Indicator	Number of direct and indirect beneficiaries* *NOTES: Direct: DOST-PAGASA, DENR-MGB, OCD and DILG staff plus local populations of Legazpi, Palo, Tuguegarao & New Bataan. Indirect Beneficiaries, according to hazard: For flood, landslide and storm surge: Provincial populations of Albay, Leyte and Davao de Oro plus Cagayan River Basin= 7,573,016 (8,040,935=total provincial populations plus Cagayan River Basin population – 467,919=direct beneficiaries) For severe wind: (using PSA data and fragility curves): total country population=101.7 million	External Evaluation Reports of the Project Annual Reports of NDRRMC, PDRRMC and CDRRMC	0	Direct Beneficiaries: At least 50% of the total population (=467,919) of the 4 project sites have access to impact-based EWS for flood, landslide, storm surge and severe wind Female beneficiaries: =116,363 Male beneficiaries: =117,597 5,000 staff of National Government Agencies and LGUs have access to impact-based EWS for flood, landslide, storm surge and severe wind Indirect Beneficiaries: For severe wind: At least 50% percent of national population (50,850,000) have access to impact-based EWS for severe wind For flood, landslide and storm surge: 3,786,508 people living in Albay, Leyte, Davao de Oro	Direct Beneficiaries: At least 80% of the total population (=467,919) of the 4 project sites have access to impact-based EWS for flood, landslide, storm surge and severe wind Female beneficiaries: =186,180 Male beneficiaries: =188,155 10,000 staff of National Government Agencies and LGUs have access to impact-based EWS for flood, landslide, storm surge and severe wind Indirect Beneficiaries: For severe wind: At least 80% of national population (81,360,000) have access to impact-based EWS for severe wind For flood, landslide and storm surge:	Project is implemented as planned

				and Cagayan River Basin have access to impact-based EWS	6,058,412 people living in Albay, Leyte, Davao de Oro and Cagayan River Basin have access to impact-based EWS	
A1.0 Increased resilience and enhanced livelihoods of the most vulnerable people, communities and regions	A1.1 Change in expected losses of lives and economic assets (US$) due to the impact of extreme climate-related disasters	Rapid Damage and Needs Assessment reports (RDNA) Post-Disaster Needs Assessment reports (PDNA) External Surveys	Previous RDNA and PDNA reports for the LGUs in project sites (to be collected upon project commencement)	At least 50% reduction of casualties in project sites Damage and losses incurred due to extreme weather events in the past 10 years cut by at least 25% based on current price as of 2022	At least 80% reduction of casualties in project sites Damage and losses incurred due to extreme weather events in the past 10 years cut by at least 40% based on current price as of 2024	Occurrence of extreme weather events in project sites; RDANA or PDNA conducted and reported
	A1.2 Number of males and females benefitting from the adoption of diversified, climate-resilient livelihoods options	LDRMMC and BDRRMC situation reports	0	At least 10% of the population (5% male and 5 % female) in the project sites (=467,919)	At least 50% of the population (25% male and 25% female) in the project sites (=467,919)	Occurrence of extreme weather events in project sites; RDNA or PDNA conducted and reported

D.3. Outcomes measured by GCF indicators

Description	Indicators	Baseline	Target (MT-2022)	Target (Final-2024)	Sources and means of verification	Assumptions
A6. Increased generation and use of climate information in decision-making	A6.2 Use of climate information products/services in decision-making in climate-sensitive sectors	Current climate information products/services in decision-making in climate-sensitive sectors are hazard-based. Existing NCCAP, NDDRM Plan, National Climate Strategy Framework, NDRRMC and LDRRMC Situation Reports	At least 50% of the total population (467,919) of the 4 project sites use the 12-hourly risk matrix, map and impact tables for strong winds, flood and landslide generated for the next 3 days for heavy rainfall and strong winds to undertake risk mitigation and early actions At least 3 government agency members of NDRRMC use the 6-hourly probabilistic forecasts for heavy rainfall, strong winds, storm surge, flood and landslide generated for the next 5 days for heavy rainfall in decision-making and prioritization	At least 80% of the total population (467,919) of the 4 project sites 6-hourly probabilistic forecasts for strong winds, flood and landslide projected to happen in the 4 project sites for the next 3 days for heavy rainfall and strong winds At least 6 government agency members of NDRRMC 3-hourly probabilistic forecasts for heavy rainfall, strong winds, flood and landslide projected to happen in the 4 project sites and 6-hourly probabilistic forecasts for storm surge in decision-making and prioritization	National and local climate change and DRM/DRR policies and plans; Pre-Disaster Risk Assessment (PDRA) reports of the N/P/LDRRM Councils, NDRRMC and LDRRMC Situation Reports	Occurrence of extreme weather events in project sites; Operational knowledge management system for MH-IBF-EWS is in place.

A5. Strengthened institutional and regulatory systems for climate and gender-responsive planning and development	A5.1 Institutional and regulatory systems that improve incentives for climate resilience and aligned with national gender mainstreaming strategy	Existing plans currently do not have MH-IBF-EWS:: - National Disaster Response Plan (NDRP) - Guidelines on the Declaration of the State of Calamity - Current SOPs on EWS of NDRRMC and LGUs - Guidelines for Gawad Kalasag - Current local resilience plans of LGUs in the project sites and local development and investment plans - LISTO Manual -National Pre-Disaster Risk Assessment (PDRA) SOP	Risk matrix with impact and response tables adopted by the NDRRMC Drafted policies on early release of funds for early action, e.g. Declaration on the State of Imminent Calamity Drafted guidelines on mainstreaming MH-IBF-EWS in national and local disaster preparedness and response plans that is gender-sensitive	Risk matrix with impact and response tables adopted by the NDRRMC Adopted and implemented policies in release of funds for early action, e.g. Declaration on the State of Imminent Calamity Final guidelines on mainstreaming MH-IBF-EWS in local resilience planning and national SOPs of collaborating members of the NDDRMC that is gender-sensitive	Annual budget of the four LGUs; Local directives; Approved national and local policies, guidelines and frameworks on MH-IBF-EWS	National Disaster Response Plan (NDRP) and EWS and SOPs are using hazard-based forecasting and warning information
	A5.2 Number and level of effective coordination mechanisms	Existing coordinating bodies: - NDRRMC - National TWG on FbF - Cagayan River Basin Management Council Local mechanisms: - LDRRMC - BDRRMC	One inter-agency national committee for MH-IBF-EWS established One task force/local committee established and led by the LGUs in the project sites Coordination Mechanisms	One inter-agency national committee for MH-IBF-EWS established One task force/local committee established and led by the LGUs in the project sites Coordination Mechanisms	National and local directives activating the EOC, N/LDRRMC and PDRA. NDRRMC, LDRRMC, BDRRMC situation reports; Meeting reports	Committees and mechanisms established at the national level and different project sites are effective.

		- Local PDRA SOP	improved to Level 3[51]	improved to Level 4		
A7. Strengthened adaptive capacity and reduced exposure to climate risks	A7.1 Use by vulnerable households, communities, businesses and public-sector services of Fund-supported tools, instruments, strategies and activities to respond to climate change and variability	0- No formal use of MH-IBF- EWS climate information in the project area	At least 50% (233,960), of the total population (467,919) of the 4 project sites use EWS services, forecasts, advisories, etc. for flood, landslide and storm surge and related impact-based EW tools, strategies and activities 4 LGUs have access and use MH-IBF-EWS knowledge and decision support system; At least 50% (3,786,508) of total indirect beneficiaries use EWS services, forecasts, advisories, etc. for flood, landslide and storm surge and related impact-based EW tools,	At least 80% (374,335) of the total population (467,919) of the 4 project sites use EWS services, forecasts, advisories, etc. for flood, landslide and storm surge and related impact-based EW tools, strategies and activities 4 LGUs have access and use MH-IBF-EWS knowledge and decision support system; At least 80% (6,058,412) of total indirect beneficiaries use EWS services, forecasts, advisories, etc. for flood, landslide and storm surge and related impact-based EW tools,	Baseline and endline survey on early warning/risk perception survey	There is continued commitment and uptake of the information by targeted communities in the project sites.

[51] The scale to measure the level of effectiveness is as follows: Level 1 = no coordination mechanism; Level 2= coordination mechanism in place; Level 3 = coordination mechanism in place, meeting regularly with appropriate representation (gender and decision-making authorities); Level 4 = coordination mechanism in place, meeting regularly, with appropriate representation, with appropriate information flows and monitoring of action items/issues raised.

			strategies and activities	strategies and activities		
	A7.2 Number of males and females reached by climate related early warning systems and other risk reduction measures established/ strengthened	0 Baseline survey on early warning system ro be undertaken	At least 50% (25% female and 25 % male) of the total population with access to EWS services, disaster preparedness and FbA in the project sites At least 50% (50,850,000) of national population reached by impact-based EWS for severe wind,	At least 80% (40% female and 40% male) of the total population with access to EWS services, disaster preparedness and FbA in the project sites At least 80% (81,360,000) of national population reached by impact-based EWS for severe wind.	LDRRMC situation report Baseline and endline survey on early warning/risk perception survey	There is continued commitment and uptake of the information by targeted communities in the project sites.

D.4. Arrangements for Monitoring, Reporting and Evaluation (max. 300 words)

71. This M&E plan presents the details and process how M&E process will be implemented and performed by the Direct Access Entity (DAE) and Executing Entity (EE) to its Co-executing Entities. Specifically, this plan intends to:
 a) Monitor and evaluate the targets based on the approved project goals and objectives;
 b) Monitor any shortcomings and/or inefficiencies with regards to the project's delivery of inputs, timely execution of activities and production of outputs; and
 c) Record factors which enhance or deter the implementation of project outputs and deliverables.

72. **PROJECT EXPECTED OUTPUTS AND DELIVERABLES**
The project will produce the following outputs: i) Science-based multi-hazard weather and risk information is generated; ii) Established MH-IBF-EWS supported by a knowledge and decision support system; iii) Improved national and local capacities in implementing a people-centered MH-IBF-EWS and forecast-based early actions (FbA); and iv) Mainstreamed climate risk information and MH-IBF-EWS in development and investment planning and policy-making processes and institutionalized people-centered MH-IBF-EWS for a more proactive and inclusive climate risk management. Please refer to Section B2 and the project logical framework in Annex 2a for details.

73. **INTERNAL MONITORING ACTION PLAN**
<u>Monitoring & Evaluation</u>
Monitoring and evaluation is a tool which LANDBANK & DOST-PAGASA will employ in the management of the Project to:

- know whether implementation activities are going as planned;
- be alert to changes or early signs of problems;
- focus resources if needed;
- enable adjustment of activities and plans to respond to unexpected events; and
- build trust with stakeholders.

For the purpose of this Project, **monitoring** is defined as the continuous and systematic assessment of the implementation and performance of a project or programme over the course of its implementation cycle. The process involves ongoing collection and review of information to measure progress against programme plans and objectives. On the other hand, **evaluation** is defined as a rigorous and in-depth and assessment of the progress of all aspects of a project or programme against its initial plan and objectives at a key point during its life cycle. Evaluations are typically undertaken at or near the mid-point of the project (a mid-term evaluation) and at the end of the project cycle (a final evaluation), and may be undertaken as internal or external exercises.

The Project's M&E will be anchored on the Logical Framework which is a methodology used for designing, <u>monitoring, and evaluating</u> <u>development</u> projects. It is basically a tool for planning and managing projects to establish how the programme activities will lead to the immediate outputs, and how these will lead to the desired outcomes and goal.

The M&E System shall be implemented, as follows:

1. LANDBANK and DOST-PAGASA shall use the Logical Framework matrix as approved in the Funding Proposal, to be the main basis in the monitoring and evaluation of the GCF programme/project.
2. DOST-PAGASA and the Co-Executing Entities shall conduct monitoring and prepare corresponding reports on a quarterly basis to be submitted to LANDBANK. On the other hand, LANDBANK shall conduct monitoring and prepare corresponding reports on an annual basis for submission to the CCC-NDA and GCF. The Monitoring Report will focus on tracking the progress of activities and attainment of targets using required inputs and measured on agreed performance indicators. The Co-executing Entities shall prepare monitoring report using a standard format for submission to the Project Management Office (PMO).
3. Mid-term evaluations shall be conducted in the context of any GCF-funded activity. Evaluation aims to determine the attainment of the project's intended impacts, outcomes and/or results measured in terms of the corresponding performance indicators. This will be conducted by an external consultant/third party. The Evaluation Report will follow the GCF Evaluation Report format, if any.
4. LANDBANK and DOST-PAGASA shall commission a third party to conduct an independent final evaluation upon project completion.
5. For all GCF funded activities, evaluation reports shall be disclosed publicly, in accordance with Information Disclosure policy for GCF-supported programmes/projects.

Monitoring the project expected outputs and deliverables stated above shall consider the following factors:

a) Resource allocation (Efficiency)
- See whether project activities are implemented within the allocated budget

b) Schedule of activity implementation (Effectiveness)
- See that the target activities are carried out within the prescribed period of time/execution

c) Achievement of milestones
- Significant project accomplishments which are not within the quantifiable/expected accomplishments of the project

d) Issues and concerns
- Constraints that affect the project implementation that needs management (especially the NDA, DAE and EE) action/intervention

e) Innovations
- Technologies, approaches and or methods employed and introduced by the project

74. In order for the NDA, DAE and EE to effectively monitor the project's status and accomplishment, weights are assigned to each project outputs indicative of their relative cost on the approved activity budget. The assignment of weights to output activities would facilitate the design of S-curve, which would determine the project's degree of completion at any given time. Thus, following scheme shall be implemented.

Project Output	Assigned Cost	Computation*	Weight (%)
Output 1: Science-based multi-hazard weather and risk information is generated	14,087,084.58	0.70	69.77
Output 2: Established multi-hazard impact-based forecasting and early warning system (MH-IBF-EWS) supported by a knowledge and decision support system.	3,120,000.00	0.15	15.45
Output 3: Improved national and local capacities in implementing a people-centered MH-IBF-EWS and forecast-based early actions (FbA).	1,939,692.31	0.10	9.61
Output 4: Mainstreamed climate risk information and MH-IBF-EWS in development policy and planning, investment programming and resilience planning at national and local levels and institutionalized people-centered MH-IBF-EWS in the Philippines.	511,207.69	0.03	2.53
Total Project Cost:	19,801,533.81	0.97	97.36+

+This excludes the PMU cost, which amounts to USD 533,365.38 or 2.64 percent.

*Computation of weight per output:

$$\textbf{Weight per output} = \frac{Total\ cost\ per\ output}{Total\ project\ cost}\ x\ 100$$

75. **Project Efficiency Rating**
This rating summarizes all the major elements that determine the project efficiency in a year. In an annual monitoring and evaluation procedure, physical accomplishment and financial utilization shall be assessed using the following table and computations:

Computation for Weighted Physical Target (WPT):

$$\textbf{WPT} = \Sigma\left(\frac{Act.1\ Target\ to\ date}{Act.1\ TPG}\ x\ AW\right) + \left(\frac{Act.\ 2\ Target\ to\ date}{Act.\ 2\ TPG}\ x\ AW\right) + \left(\frac{Act.3\ Target\ to\ date}{Act.3\ TPG}\ x\ AW\right)$$

Computation for Weighted Physical Accomplishment (WPA):

$$\textbf{WPA} = \Sigma\left(\frac{Act.1\ Cum.Accomplishment}{Act.1\ TPG}\ x\ AW\right) + \left(\frac{Act.\ 2\ Cum.Accomplishment}{Act.\ 2\ TPG}\ x\ AW\right) + \left(\frac{Act.3\ Cum.Accomplishment}{Act.3\ TPG}\ x\ AW\right)$$

76. On the other hand, in any case that the project is unable to meet an expected output on a given time, work slippage/overrun shall be reported. This refers to the value of work that the activity has been accomplished slower/faster than estimated time of completions and will likewise to cause some positive/negative impact in the succeeding years of project's implementation. To determine whether the project is ahead or behind of its work schedule, the following computation shall be used:

% Work Slippage / Overrun = *Total WPA – Total WPT*

Negative result would mean that the project has a work slippage or is behind the scheduled target of activity completion. On the other hand, positive result would mean that the project has overrun or is ahead of schedule.

77. To equate this % work slippage/overrun into actual number of months the project is ahead or behind schedule, the following computation shall be applied:

Number of Months Ahead/Behind = *% Work Slippage x Project Duration*

78. Evaluation shall be a done at Mid-Project and after Project Completion by a third party evaluator. This shall be commissioned by the EE with concurrence by the DAE. In the conduct of evaluation, the following evaluation criteria shall be observed and implemented:
    1. **Impact**
        - Result and/or long-lasting effect or consequence of the project in terms of:
            - Economic (esp. for the increase livelihood objective of the project)
            - Socio-cultural (i.e. community participation/adaptation to the project)
            - Political (i.e. adoption of the LGU to the project initiatives)
            - Technological (technologies to be introduced by the project)
            - Institutional (i.e. linkages and partnerships between and among executing agencies)
            - Ecological/Environmental (i.e. impact of the project to the environment)
    2. **Effectiveness**
        - Extent to which the project achieves its objective and intended outputs
    3. **Efficiency**
        - Measure of the extent to which the project has achieved its objectives using the allotted resources (i.e. funds, logistics, etc.)
    4. **Relevance**
        - Measure to the extent to which results and impacts of a project conform with the intended goals and objectives
    5. **Sustainability**
        - Ability of the project to continue and further develop the innovations and benefits the it has initiated to the intended beneficiaries

79. A Monitoring and Evaluation (M&E) officer will be hired under the PMO to conduct and coordinate the M&E of the project. The M&E Officer will design a performance monitoring framework to track the project's progress towards achieving its targets. As mentioned earlier, a GCF Program Team shall be established by LANDBANK which shall conduct supervisory mission twice a year during the implementation period to ensure that the Project is being implemented in accordance with the legal agreements that the Bank have entered into with the GCF.

E. EXPECTED PERFORMANCE AGAINST INVESTMENT CRITERIA

E.1. Impact potential (max. 300 words)

E.1.1. Expected tons of carbon dioxide equivalent (t CO_2 eq) to be reduced or avoided (Mitigation only)	Annual	Click here to enter text. tCO_2 eq
	Lifetime	Click here to enter text. tCO_2 eq
E.1.2. Expected total number of direct and indirect beneficiaries, disaggregated by gender	Direct	467,919 people Female population = 232,725
	Indirect	8,040,935 people
	**For both, Specify the % of female against the total number.*	
E.1.3. Number of beneficiaries relative to total population	Direct	0.5% (Expressed as %)
	Indirect	8.0% (Expressed as %)

80. The project is envisioned to increase resilience reduce loss of lives, properties, and livelihoods due to climate-induced threats. The direct beneficiaries of the project (directly trained under Outputs 1, 2 and 3 at the national level are estimated at 10,000. At the project site level, direct beneficiaries are estimated to be 467,919 (i.e. Tuguegarao City, Cagayan-153,502; Legazpi City, Albay-196,639; New Bataan, Compostela Valley (Davao de Oro)-47,726; and Palo, Leyte-70,052 based on 2015 Census. Indirect beneficiaries of the project, those who will benefit from receiving impact-based forecasts, early warnings and risk information that can be used for proactive preparedness and response, improved adaptation strategies, risk-sensitive land use planning and decision-making are the populations living in the Cagayan Valley River Basin (i.e. provinces of Cagayan, Cagayan, Apayao, Kalinga, Mountain Province, Ifugao, Isabela, Nueva Vizcaya, Quirino, Aurora) – 3,601,484; Albay Province with 1,314,826 people; Compostela Valley with 736,107 people; and Leyte Province with 2,388,518 people. These provinces are expected to be part of the geographic upscaling of the impact-based early warning system during and after project lifespan. Total estimated number of indirect beneficiaries is 8,040,935. Further, with the implementation of impact-based forecasting at the national level, specifically for severe wind and strong rainfall in the event of tropical cyclones or typhoons, for which probabilistic forecasts will be made at the provincial level (Output 1), the entire country population of 101.7 million will indirectly benefit from improved forecasts and warnings, of which about 50 percent are women and about 33 percent are children or boys and girls aged 0-14 years old.

E.2. Paradigm shift potential (max. 300 words)

81. The project will usher in a paradigm change in the fundamental way government authorities and the public understand and respond to weather forecasts and early warnings. From the traditional hazard-based forecasts and warnings, the project will drive DOST-PAGASA to innovate from its current hazard-focused approach to an integrated multi-hazard impact-based forecasting and early warning system (MH-IBF-EWS) that will enable at-risk communities, national and local authorities, humanitarian agencies and the general public to take early actions during the "window of anticipation" or "lead time" before the hazard event occurs. The proposal provides a well-articulated conceptual framework that details elements of the proposed interventions and their integration. The proposed approach also adopts the best available science and technology developed by WMO and partners to establish a multi-hazard impact-based early warning system consisting of impact-based forecasting and forecast-based actions. Firstly, the project will allow DOST-PAGASA to adopt a new model for weather forecasting, shifting from deterministic to probabilistic forecasting techniques that produce information on the most likely impacts of a severe weather event and reasonable worst-case scenarios. It also highlights the need to distinguish between forecasting an event, such as a tropical cyclone, from the potential hazards resulting from that event, e.g. flood, landslide, storm surge, and severe wind, based on which risks and impacts are to be estimated.

82. Secondly, at the local level, MH-IBF-EWS will require translating hazard forecasts and warnings into location- and sector-specific impacts, providing tailored climate risk information directly to local and national governments, vulnerable communities and stakeholders in the project sites, and the generation of corresponding actions and protocols that can be taken before, during and after the event. Improving people's understanding of potential impacts of extreme weather events are essential in increasing the effectiveness of EWS. This change further emphasizes the expanded role of last-mile communities, particularly communities at-risk, local authorities, NGOs and humanitarian agencies on the ground, so no one is left behind. This requires active engagement and participation of end-users in designing and communicating forecasts and warnings and in decision-making processes such as planning pre-disaster preparedness measures, priority early actions that should be taken during the lead time in advance of the event, and emergency response actions to avoid loss of life, mitigate adverse impacts on livelihoods, properties, and economy and elevate the effectiveness and

efficiency of disaster response, recovery, and rehabilitation efforts. Forecast-based early actions (FbA) including financial mechanisms required to enable such actions including identification of climate-resilient livelihoods and shock-responsive social protection strategies will become an integral part of disaster preparedness and early action plans.

83. Understanding how a climate-related hazard can produce a series of social, economic and physical impacts implies that local authorities and stakeholders will need to be involved in identifying these potential impacts in their respective localities, because this is not the sole responsibility of DOST-PAGASA and DENR-MGB (for landslides). By focusing on impacts, the identification of location- and sector-specific impacts and determination of responses to mitigate those impacts become the responsibility of both DOST-PAGASA, the producer of impact-based forecast and warning information, and the end-users of such information. Thus the proposed project will bring about a shift in the planning, managing and adapting to climate risks and require close collaboration with at-risk communities, local authorities, humanitarian agencies, and NGOs on the ground as well as national agencies such as OCD and DILG. More effective operational partnerships and coordination between DOST-PAGASA and national and local governments, NGOs and stakeholders will become the norm to enhance the delivery of climate and weather information services and effectively support climate risk management.

84. Delivering impact-based forecast and warning services will also require engaging local and national governments in adopting and mainstreaming MH-IBF-EWS. Integrating MH-IBF-EWS in local resilience planing will increase the use of climate risk information in institutional policy-making and sectoral planning processes, strengthen institutional systems for climate-responsive development planning, and mitigate medium- to long-term climate risks as a proactive adaptation intervention. Ensuring that warnings reach the most vulnerable and that they are able to understand and sufficiently resourced to act on them will increase their awareness of and reduce their exposure to climate risks, enhance both their absorptive and adaptive capacities, improve climate risk management and bolster community adaptation to climate change.

85. Lastly, these paradigm and operational shifts on the side of DOST-PAGASA, i.e. phenomenon-based to impact-based, products-based services to decision support services, meteorological threshold-based warning to impact threshold-based warning, and deterministic to probabilistic forecasting, will be accompanied by technological innovation in the form of a knowledge and decision support system that the project will develop. It will establish a high-performance computing infrastructure with big data analytics that provides enormous computational power to improve forecasting and warning services. This system will consist of tools and functionalities that will revolutionize the way forecasts and warnings are designed, communicated and distributed to end-users down the line. The knowledge and decision support system will use the latest technology to integrate the tasks of modelling and predicting severe weather events through to impact, generate ensemble prediction that allows more rapid and scientific-based comparison of multiple model forecasts, and provide a more robust estimate of uncertainties that will increase efficiency and effectiveness of impact-based forecasting and warning. Such scientific information will be visualized and disseminated in the form of user-friendly probabilistic hazard maps with accompanying impact tables and response tables usable to last-mile communities. This system will also integrate functionalities that are meant for disaster risk managers and decision makers at national and local levels by providing tools to visualize hazard and risk information in spatial format as well as enable users to store, organize and manage data required to assess risks and exposure of any target area. This will facilitate the conduct of risk assessment, the results of which can be used for local resilience planning and for mainstreaming risk information in local development planning and investment programming.

E.3. Sustainable development (max. 300 words)

86. The project has significant social, economic, environmental, as well as gender-sensitive development co-benefits. With the avoided loss of assets and livelihood sources, the project will help reduce loss of income and alleviate poverty in the project sites. It will also bring about sustained local economies as local economic production and exchanges are expected not to be significantly disrupted due to more strategic risk-informed local development planning and investment programming. Increased social cohesion will also be promoted as community-based initiatives are expected to provide venues for community discussions and collaboration. Further, the information generated by the system will help protect natural resources that serve as buffer to more adverse impacts of hazards and are livelihood sources of local communities. Lastly, gender and development strategies will be promoted and integrated to the interventions in order to contribute to identifying and addressing gender-based vulnerabilities in the project sites.

87. The project will also contribute to sustainable development in the country. The project supports the implementation of the Philippine Development Plan 2017-2022 in terms of the development of adaptive capacity of the public sector in anticipating risks from natural hazards and climate change impacts, strengthening of inter-agency coordination and linkages, development of climate and disaster responsive technologies and innovations, capacity development of local planners for multi-scenario analysis and climate change projections, development of capabilities and maximization of the use of core and emerging technologies for CCA, development, maintenance, and ensuring of accessibility of climate and geospatial information, establishment and promotion of innovation hubs on climate change and services, and identification of technological and research priorities and capacity needs on CCAM and DRRM.

88. The Philippines National Framework Strategy on Climate Change (2011-2028) identifies the need to establish climate information system and database, which is aligned with the outputs of the project. In the same vein, the National Climate Change Action Plan prioritizes the objective of the human security agenda, particularly to reduce the risks of women and men to climate change and disasters and the objective of enhanced knowledge on the science of climate change through enhancing the capacity for climate change adaptation and disaster risk reduction at the local and community level and establishing climate change knowledge management accessible to all sectors at the national and local levels are clearly supported by the project's outputs as well.

89. In terms of global policies and priorities for reducing climate-induced hazards and risks, the Sendai Framework for Disaster Risk Reduction or Sendai Framework endorses the use of multihazard EWS as a sound disaster risk reduction investment strategy and promotes the incorporation of disaster risk reduction in development and planning processes. One of the major goals declared in Sendai Framework is to "substantially increase the availability of and access to multi-hazard EWS and disaster risk information and assessments to the people by 2030," which is one of the project's main outputs. Target G specifically mentions that by 2030, substantial increase in the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people should be achieved. Further, Sendai Framework declares under Priority 3-Investing in disaster risk reduction for resilience that both national and local level government agencies must "(f) promote the mainstreaming of disaster risk assessments into land-use policy development and implementation, including urban planning, land degradation assessments and informal and non-permanent housing, and the use of guidelines and follow-up tools informed by anticipated demographic and environmental changes" and "(g) promote the mainstreaming of disaster risk assessment, mapping and management into rural development planning and management of, inter alia, mountains, rivers, coastal flood plain areas, drylands, wetlands and all other areas prone to droughts and flooding…."[52] which are fully supported by the project. In this regard, by also incorporating risk assessment in development planning and establishing early action protocols, the project will help in the attainment of Target A: Substantially reduce global disaster mortality by 2030, aiming to lower the average per 100,000 global mortality rate in the decade 2020- 2030 compared to the period 2005-2015.

90. In terms of Sustainable Development Goals, the project is aligned with Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable, specifically target 11.5 which states that by 2030, number od deaths and number of people affected should be significantly reduced and direct economic losses relative to GDP be substantially decreased, including for water-related disasters, with a focus on protecting the poor and people in vulnerable situations. In addition, Goal 11.b aims to substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels by 2020. Further, the proposed project supports Goal 13: Take urgent action to combat climate change and its impacts, specifically target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters; target 13.2: Integrate climate change measures into national policies, strategies and planning and target 13.3: Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning. Impact-based forecast and warning services has also been identified as a high priority by the World Meteorological Organization (WMO) to increase the relevance and utility of forecasts and warnings.

E.4. Needs of recipient (max. 300 words)

91. **Vulnerability.** Located in the Pacific Ring of Fire and along the typhoon path, the Philippines is vulnerable to the impacts of natural hazards, which are intensified with the onset of climate change. The warm, equatorial waters power storms, about 20 typhoons per year, where low-lying coastal islands and coastal zones serve as

52 UNISDR. 2015. *Sendai framework for disaster risk reduction 2015–2030*. Geneva: UNISDR.

home to more than 60% of the population. Storm surges for landfall of Super Typhooon Haiyan reached 23 feet (7 meters) in some places, and were more than 16 feet (5 meters) high. Those waves rolled over low-lying parts of populated islands such as Leyte, home to the coastal city of Tacloban, where 10,000 people died. The long-term CRI indicates that in the 20-year period, the Philippines ranks on the top five countries. In addition, 60% of the country's total land area is exposed to multiple hazards and as a result, 74% of Filipinos are at risk. In an analysis of natural disaster hotspots by the Hazard Management Unit of World Bank, the Philippines is among the countries where large percentage of population reside in disaster-prone areas. Many highly populated areas are exposed to multiple hazards: 22.3% of the land area is exposed to three or more hazards and in that area, 36.4% of the population are exposed. Areas where two or more hazards are prevalent comprise 62.2% of the total area where 73.8% of the population are exposed. In 2017, economic losses due to 22 tropical cyclones, flashfloods, and intertropical convergence zones amounted to approximately USD 121 million, according to OCD-NDRRMC. The data does not include the cost of damage to private properties, commercial activities, and foregone revenues from the hundreds of people who died as a result of calamities. Lastly, in terms of Average Annual Loss (2017), or the expected loss per annum associated to the occurrence of future climate-linked hazards is estimated to be USD 7,158.73 M.

92. **Vulnerable Groups and Gender aspects.** There is a growing body of research illustrating the adverse impacts of storms and related flooding on women living in urban settings in both developing and developed countries. In the Philippines, post-typhoon vulnerability assessments found that female-headed households were more likely to be vulnerable to flooding and other storm-related impacts (343). After Typhoon Ondoy struck Manila, female-headed households experienced greater damage costs, while male-headed households experienced greater temporary loss of income, likely due to a reliance on manufacturing employment among men, which took longer to resume after the floods (*Gender and Climate Change:A Closer Look at Existing Evidence).* As mentioned earlier, the project will aid in integrating climate and disaster-risk considerations in local planning and programming to increase the communities' adaptive capacity.

93. **Economic and Social Development level of the country and affected population.** The Philippines is a lower middle income country and ranks 113th on the Human Development Index. Despite the recent economic growth, a substantial part of the population (22 million) still live below the poverty line. Despite the generally good economic performance, poverty remains high and the pace of poverty reduction has been slow. Latest data from the World Bank showed poverty decline in recent years, with 21.6% of Filipinos living below the poverty line in 2015, compared to 26.6% in 2006.

94. **Vulnerability of Project Sites**. The project will have a local level scope that will be implemented in four project sites: Tuguegarao City, Legazpi City, Municipality of Palo, and Municipality of New Bataan. The hazards for these four project sites were chosen based on historical data on their frequency and high level of impact in these areas. The following paragraphs summarize the vulnerability and risk of the project sites due to these hydrometeorological hazards.

95. Tuguegarao City in Cagayan Province is a third class component city in the Philippines with a population of 153,502 (2015 census) with 77,622 female and 75,880 male population. About one third of the population or 47,119 are considered highly vulnerable to hazards as these are aged 0-14 and over 65 years of age. It is the capital of the province of Cagayan and the regional and institutional center of Cagayan Valley (Region II). It composed of 49 villages of barangays and has a total land area of 144.80 km2 with 30m elevation. Within the past three decades, its economy gradually shifted from agriculture to secondary/tertiary economic activities such as trading, commerce and services. The shift was ushered by Tuguegarao's role as the Regional Government Center and Center of Commerce in Northern Luzon. Based on the number of tropical cyclones (TCs) from 1951-2018 data of 1° latitude x 1° longitude square grid , a total of 66-110 TCs have crossed the province of Cagayan. Also, data on TCs with high wind speeds from 1971-2013 showed that extreme TCs have become slightly more frequent (Cinco et al., 2016). These events have caused a lot of damage and losses in Cagayan especially when it comes to rain-induced flood and severe wind impacts. Being the catch basin of the waters from different tributaries of Cagayan, is considered to be most vulnerable to flooding during the last few decades (Gannaban et.al., 2018). Yearly, the city's constituents, especially the farmer and those living near the riverbanks, suffer so much due to flashfloods. During the TY Haima, one of the most disastrous TY that stuck Cagayan, at least 1.5 million people were negatively affected (Gannaban et al., 2018). This has caused severe flooding which negatively influenced 10,100 households of the region. Damages to infrastructure is estimated around Php7 billion plus the reported damage to government infrastructure that has reached to P46 million (Cagayan PDRRMC). Since the intensity of a typhoon is being measured by its associated wind speed, Tuguegarao City was identified to be one of the vulnerable to severe wind impacts. In fact, based on the NDRRMC's situation report published during 16- 20 October 2016 (TY Haima), the following damages were

reported: 304,553 families or 1,386,587 persons were affected in 1,836 barangays in Region II of which 198,385 families; (899,397 persons) in 792 barangays are residents of Cagayan, and 136,324 houses (25,388 totally and 164,324 partially damaged) were damaged.

96. Legazpi City is composed of 70 barangays and is a first class component city and the capital of the province of Albay in the Philippines. It has a population of 196,639 (2015 census) broken down into 98,477 female and 98,192 male population. The children (60,779) and elderly (9,990) accounted for 70,769 of the total population. It has a total land area of 153.70 km2 with 47m elevation. Legazpi is the regional center and largest city of the Bicol Region, in terms of population. In terms of TCs, Legazpi City has the same number of tropical cyclones with Cagayan as per 1951-2018 data. For the last 63 years, this city has been one of the areas most frequently hit by TCs which entered PAR. According to the study conducted by Japan International Cooperation, approximately 70ha get flooded 3-5 times per year by 1-day storm rainfall (~60mm/day). On the other hand, areas that are occasionally flooded are approximately 180ha where floods occur once a year by 3-day storm rainfall (~200mm/day). During Typhoon Durina (Reming), an accumulated 466 millimeters of rainfall for a 12-hour record (daily rainfall) on 30 November 2006 was recorded on the day the widespread debris flow occurred. It was 40 years ago when similar amount of rainfall was last recorded in the Province of Bicol. Typhoon Durian moved slowly over Legazpi and overwhelmed the area with rainfall intensity of 135 mm/hr (3:00pm hourly rainfall data). Per the 16 Dec 2006 report of the Bicol Provincial Disaster Coordinating Council (PDCC), 518 people died and some 648 missing, while 45,199 houses were partially damaged and 68,617 houses were totally damaged.

97. The Municipality of Palo is located in the north-eastern part of the province of Leyte with a population of 70,052 (2015 census) broken down into 34,082 female and 35,970 male population. Children numbered 23,340 while the elderly population was 3,132. Composed of 33 barangays, Palo was declared as 3rd class municipality in the province of Leyte, Philippines (citation). It has a total land area of 221.27 km2 (85.43 sq mi) with 8.9m (29.3 ft) elevation. Unlike Cagayan and Legazpi City, province of Leyte has a lesser number of TC frequency based on 1951-2018 data. According to the 1° latitude x 1° longitude square grid, a total of 21-50 TCs crossed over the province. However, one the strongest typhoons that hit the Philippines, Haiyan, significantly devastated Eastern Visayas, particularly the provinces of Leyte and Samar in November 2013. Typhoon Haiyan was the world's strongest typhoon in 2013, with a maximum sustained wind of 235 kph and gustiness of 275 kph that brought devastation of catastrophic proportions in its wake where more than 90 percent of homes and infrastructures in Samar and Leyte were destroyed and communication cut off due to strong winds. Preparing for storm surges induced by tropical cyclones is one of the most important challenges that many coastal areas in the world are currently facing. During the same event (TY Haiyan), a large-scale devastation struck Leyte with strong focus in the Municipality of Palo and Tacloban. According to the latest report from the NDRRMC, the total numbers of dead and missing due to the typhoon were 6,300 and 1,061, respectively, as of 17 April 2014. Most of the casualties were reported in two islands: Leyte (5,402 dead and 931 missing) and Samar (492 dead and 74 missing). The damage was largely caused by high winds and storm surge and storm waves induced by the typhoon.

98. The Municipality of New Bataan, a small agricultural town of mostly farmers on banana plantations, is situated north and west of Davao de Oro province with a population of 47,726 with 22,544 female and 25,182 male population. There were 15,265 children and 2,346 elderly in 2015. The municipality is also home to two indigenous communities, namely, Mansaka and Mandaya, that inhabit the remote mountainous barangays of Cagan, Manurigai and Pagsabangan. At the time of this writing, there was no population data available on the indigenous communities. However, these three barangays had a total population of 5,431. The municipality is surrounded by mountain ranges and more than 50% of its territory is forest cover that has been the source of living for its residents. Composed of 16 barangays, New Bataan is a first class municipality with total land area of 553.15 km2. Unlike the previous project sites, New Bataan was not regularly frequented by typhoons. However, the recent Typhoon Pablo (international name, Bopha), a total of 612 people died due to landslide brought about by the heavy rains caused by the typhoon. The high winds and heavy rainfall resulted in landslides in the hinterland. Barangay Andap was buried under a pile of rocks and boulders. Heavy rains brought by the typhoon caused flooding which carried eroded gravel, boulders, and other debris from the mountains which slid down to the community (Lagmay et al., 2013). According to the situation report by NDRRMC on 25 December 2012, a total number of 711,682 families/6,243,998 persons in 3,064 Barangays/318 municipalities / 40 cities / 34 provinces of Regions IV-B, VI, VII, VIII, IX, X, XI, XII, CARAGA and ARMM, of which New Bataan is situated, were affected. After the declaration of the State of National Calamity thru Proclamation No. 522, dated December 7, 2012, a total number of 4,567 (1,067 dead, 2,666 injured and 834 missing) casualties were reported with millions worth of damage to properties.

99. **Absence of alternative sources of financing.** The Government of the Philippines is committed to the improvement of its forecasting and climate information systems. However, budget constraints due to large investments in poverty alleviation and infrastructure, limit the resources available for other activities. As disasters strike more frequently, the cost of disaster response and mitigation also increases. But the national budget continues to lag behind, unable to meet the country's many competing needs. The composition of government expenditures, particularly the share of nonmandatory expenses, leaves little room for flexibility to allow a bigger impact on disaster spending. In the case of LGUs, they have varying disaster-related expenditure demands and revenue-raising capacities which are both affected by the incidence and severity of calamities that strike them.

100. While it cannot be denied that there have been significant innovations in the area of disaster preparedness and considerable amount of funds spent for the said phase, its various elements are continuously being challenged. Community participation and decentralization is ensured through the delegation of authority and resources to local levels, but existing financial constraints continue to affect the capacity of certain LGUs for effective disaster preparedness and response.

101. **Needs for strengthening institutions and implementation capacity.** To implement this proposed project, capacity development has to happen at various levels involving a variety of sectors and key institutions. A collective national capacity needs to be built to enable the country to address the climate change problem, especially its impacts. This national capacity building process has started at the national government level. However, those at the frontlines (LGUs, community leaders, and community-based organizations) have barely been capacitated. Their technical capacity and know-how have to be immediately placed at par with national actors. Local academic institutions and private sector actors also need increased competencies on climate change to be able to effectively support players at the local level.

102. The diversity of scientific expertise among partnerships will enable to address highly complex situations and help to ensure that work is completed efficiently to produce scientifically robust and practically relevant impact-based forecasting products. The value of working together as partners is not just in the development of products, services and research but also in the building of organizational and individual relationships and trust within the public sector, providing, among other things, a catalyst for innovation and growth. This will also strengthen the exchange of knowledge, ideas, expertise, intelligence and best practice in matters relating to natural hazards and provide a timely, common and consistent source of advice to government and emergency responders for civil contingencies and disaster response. This will provide a basis for the longer-term strategic view necessary for an effective national disaster risk platform.

E.5. Country ownership (max. 500 words)

103. The Government of the Philippines enshrines climate risk management and climate change adaptation as a top priority in its national development agenda and policies. This is evidenced by the 2019 General Appropriations Act of the Philippines which specifically highlights provisions in the budget for the establishment of a Multi-hazard Impact-based Forecasting and Early Warning Systems and the creation of Local Disaster Risk Reduction and Management Office in all LGUs. This national budget policy cements the commitment of the national government to elevate the country's capacities, resources and systems for a more effective climate and disaster risk management and climate change adaptation.

104. The project likewise aligns with the three components of DOST-PAGASA's Roadmap Towards a World Class Atmospheric/Meteorological-Hydrological Agency for 2018-2022: i) Enhancement of research and development capability through rationalized and integrated approach (including EWS; numerical modelling regional and other tools; enhanced forecast system for rain-induced landslides, systematic standardized verification scheme for long-range forecasting; and sectoral impact-based climate change scenarios); ii) Establishment of regional weather service centers through enhancement of weather/climate and related services and establishment of flood forecasting and warning sub-centers in strategic areas; and iii) Development of regional and international cooperation program through collaboration and linkages. The Roadmap was formulated in view of the enactment of the DOST-PAGASA Modernization Act of 2015.

105. As the demand for more accurate, timely and effective weather information increases, DOST-PAGASA is improving its resources to come up with a better understanding of meteorological, hydrological, and climatological phenomena that occur in the country. DOST-PAGASA is enhancing its weather monitoring and observing facilities through the densification of different weather observation networks to broaden its base for delivery of service to the countryside. The progression in scientific know-how will ultimately ensure better mitigation and adaptation strategies. These initiatives are embedded in its Strategic Plan for 2018-2022 which

outlines the collective efforts to sustain and help create a disaster and climate resilient nation. The Stategic Plan includes programs and projects identified in the DOST-PAGASA Modernization Program. This project will not duplicate any of these initiatives because the emergence of MH-IBF-EWS was not yet apparent at that time, and therefore no resources were allocated for transforming the way it operated from a hazard-based forecasting paradigm to an impact-based forecasting and warning system.

106. The project likewise aligns with the strategies and priorities identified for "Forecasting, early warning and disaster risk communication" and "Knowledge and Capacity Development" in the National Climate Change Action Plan (2011-2028) and National Framework Strategy on Climate Change (2010-2022) (see page 23, paragraph 61). The Philippines' Intended Nationally Determined Contributions Communicated to the UNFCCC on October 2015 "strives to ensure that climate change adaptation and disaster risk reduction are mainstreamed and integrated into the country's plans and programs at all levels. The path towards a low emission development will require climate resilience and improved adaptive capacity." The project will produce outputs that will support the integration of climate risk management and adaptation in development policies and plans as well as enhance existing national and local resilience plans (i.e. DRRM plans, CCA plans) by the institutionalization of MH-IBF-EWS at national and local levels.

107. The project activities that address issues and concerns related to the last mile and role of end-users were developed in close consultation with national and local stakeholders and based on assessment of local contexts. Four stakeholders consultation workshops were conducted by DOST-PAGASA, LANDBANK and Climate Change Commission to delineate the scope of the project, identify the different stakeholder group and their respective roles and contributions to the project, solicit inputs in the development of the funding proposal, and assess the gaps and challenges in the existing forecasting and early warning systems in the country (See Annex 2a).

108. LANDBANK is the largest government financial institution, the official depository bank of the Philippine Government, and 4th biggest bank in the country. It has 403 branches and 44 lending centers covering all provinces of the country. LANDBANK has taken the lead in extending timely financial and development support to small farmers and fisherfolks, micro, small and medium enterprises, local government units, agri-infrastructure, agri-business, environmental projects, among others, which it considers its priority sectors.

109. The Climate Change Commission as the NDA and the LANDBANK as the DAE have been a part of the whole process of developing the funding proposal beginning with the Concept Note stage and first consultation with stakeholders. They have provided advice and technical support by participating in all the meetings and numerous discussions held by DOST-PAGASA together with Co-executing Entities, i.e. DENR-MGB, OCD, DILG and WFP. In view of the above, country ownership is strong as there is sustained engagement of key national government agencies and the project's focus on community and public sector collaboration.

E.6. Efficiency and effectiveness (max. 1 page)

E.6.1. Estimated cost per t CO_2 eq, defined as total investment cost / expected lifetime emission reductions (Mitigation only)	(a) Total project financing	US$_______
	(b) Requested GCF amount	US$_______
	(c) Expected lifetime emission reductions	_______ tCO_2eq
	(d) Estimated cost per tCO_2eq (d = a / c)	**US$_______ / tCO_2eq**
	(e) Estimated GCF cost per tCO_2eq removed (e = b / c)	**US$_______ / tCO_2eq**
E.6.2. Expected volume of finance to be leveraged by the proposed project/programme and as a result of the Fund's financing, disaggregated by public and private sources (Mitigation only)	(f) Total finance leveraged	US$_______
	(g) Public source finance leveraged	US$_______
	(h) Private source finance leveraged	US$_______
	(i) Total Leverage ratio (i = f / b)	_______
	(j) Public source leverage ratio (j = g / b)	_______
	(k) Private source leverage ratio (k = h / b)	_______

F. ANNEXES

F.1. Mandatory annexes

☒	Annex 1a	NDA No-objection Letter(s)
☒	Annex 2a	Pre-feasibility study (including Theory of Change, project/programme-level log frame, timetable, map, and summary of stakeholder consultation and engagement plan)
☒	Annex 3a	Budget plan that provides breakdown by type of expense (Template in excel sheet)
☒	Annex 3b	Co-financing from DOST-PAGASA
☒	Annex 4	Gender assessment and action plan (Template)
☒	Annex 5a	DOST-PAGASA Co-financing commitment letter
☒	Annex 5b	WFP commitment letter
☒	Annex 5c	MGB commitment letter
☒	Annex 5d	DILG commitment letter
☒	Annex 5e	OCD commitment letter
☒	Annex 5f	Legazpi City LGU commitment letter
☒	Annex 5g	Tuguegarao City LGU commitment letter
☒	Annex 5h	Palo LGU commitment letter
☒	Annex 5i	New Bataan LGU commitment letter
☐	Annex 6	Term sheet and evidence of internal approval
☒	Annex 7	Risk assessment and management (Template)
☒	Annex 8	Procurement plan (Template)

G.2. Other annexes to be submitted when applicable/requested

☒	Annex 9	Legal due diligence (regulation, taxation and insurance)
☒	Annex 10	WFP Baseline Assessment and Case Study Development on Financing for Early Actions on Climate Risks in the Philippines
☒	Annex 11	Philippines Forecast-based Financing Lessons Learned (2015-2017)
☒	Annex 12	4th National Dialogue Platform on Forecast-based Financing
☒	Annex 13	DOST-PAGASA Information Flow
☒	Annex 14	Country Assessment Report for the Philippines
☒	Annex 1b	AE Letter to GCF for the MH-IBF-EWS Funding Proposal
☒	Annex 2b	Focus Group Discussion on Early Financing and Early Action Protocols and 4th Stakeholder Consultation Workshop on MH-IBF-EWS
☒	Annex 2c	JICA Study on the Impacts of Climate Change upon Asian Coastal Areas: The case of Metro Manila
☒	Annex 2d	Operation and Management Plan
☒	Annex 2e	2019 Philippine General Appropriations Act – Climate Change-Related Provisions

** Please note that a funding proposal will be considered complete only upon receipt of all the applicable supporting documents.*