Philippines
PAGASA

TECHNICAL COOPERATION PROJECT
FOR
ENHANCING CAPACITY ON
WEATHER OBSERVATION, FORECASTING
AND WARNING
IN
THE REPUBLIC OF THE PHILIPPINES

Project Completion Report

May 2017

Japan International Cooperation Agency

Japan Meteorological Business Support Center

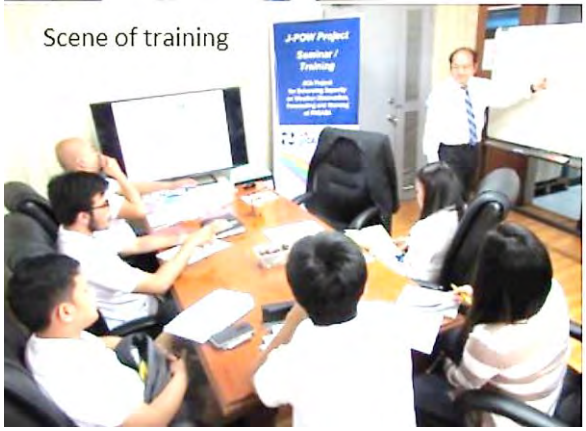
Photos (1)

The 3rd JCC Meeting (9 July 2015, PAGASA)

Weather Guidance Training (Output 2b)

Radar Maintenance Training (Output 1a)

Presentation in the 3rd JCC meeting



Radar Data Analysis Training (Output1a)

Awareness Activity Team Discussion (Output5)

Photos (2)

Consultation Meeting on DRR Collaboration in Legazpi city

Instrument Maintenance Lecture (Output1b)

Weather guidance Technical Presentation (Output2b)

Google Analysis Training (Output 4)

Trial Awareness Seminar in Southern Luzon (Output 5)

Photos (3)

J-POW meeting (June 2016, J-POW)

Radar Maintenance Training (Output 1a)

Traceability Seminar (Output 1b)

ARG Installation Work (Output 2a)

ARG Installation Work (Output 2a)

Photos (4)

The 1st Awareness Raising Seminar (Nov. 2015, Output 5)

Weather Guidance Training (Jan. 2016, Output 2b)

5th JCC (June. 2016, J-POW)

Mobile APP Presentation (Output 4)

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Abbreviation - 1

Abbr.	Full Spelling
ADB	Asian Development Bank
ARG	Automatic Rain Gauge
AWLG	Automatic Water Level Gauge
AWS	Automatic Weather Station
C/P	Counterpart Personnel
DILG	Department of Interior Local Government
DOST	Department of Science and Technology
DPWH	Department of Public Works and Highways
DRRM	Disaster Risk Reduction and Management
EFCOS	Effective Flood Control Operation System
FFWS	Flood Forecasting and Warning System
GIS	Geographic Information System
GSM	Global Spectrum Model
HMD	Hydrometeorology Division
JCC	Joint Coordinating Committee
JICA	Japan International Cooperation Agency
JMA	Japan Meteorological Agency
LIDAR	Light Intensity Detection and Ranging
LGU	Local Government Unit
M/M	Minutes of Meeting
MIC	Meteorological Instrument Center
MOS	Model Output Statistics
NCR	National Capital Region
NEDA	National Economic and Development Authority
NDRRMC	National Disaster Risk Reduction and Management Council
NGO	Non-government Organization
NOAH	Nationwide Operational Assessment of Hazards
NWP	Numerical Weather Prediction
OCD	Office of Civil Defense
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PCG	Philippine Coast Guard
PDM	Project Design Matrix
PO	Plan of Operation
R/D	Record of Discussion
RIC	Regional Instrument Center
SATAID	Satellite Animation and Interactive Diagnosis
SMS	Short Messaging Service
SNS	Social Networking Service
SYNOP	Surface Synoptic Observation
W/P	Work Plan
WB	World Bank
WD	Weather Division
WMO	World Meteorological Organization

Abbreviation - 2 (PAGASA Contexture)

Abbr.	Full Spelling
OA	Office of the Administration
AD	Administrative Division
RMS	Records Management Section
HRMDS	Human Resource Management and Development Section
GSS	General Services Section
FPMD	Financial, Planning and Management Division
BS	Budget Section
AS	Accounting Section
MS	Management Section
PPDS	Plans and Programs Development Section
ETSD	Engineering and Technical Services Division
IRDU	Instrument Research and Development Unit
ICTU	Information and Communication Technology Unit
WD	Weather Division
WFS	Weather Forecasting Section
MDIES	Meteorological Data and Information Exchange Section
ICTU	Information and Communication Technology Unit
TAMSS	Techniques Application and Meteorological Satellite Section
MMSS	Marine Meteorological Services Section
AMSS	Aeronautical Meteorological Services Section
HMD	Hydro-Meteorology Division
FFWS	Flood Forecasting and Warning Section
HMDAS	Hydrometeorological Data Application Section
HTS	Hydrometeorological Telemetry Section
CAD	Climatology and Agrometeorology Division
CADS	Climate and Agromet Data Section
IAAS	Impact Assessment and Application Section
FWSS	Farm Weather Services Section
RDTD	Research and Development and Training Division
CARDS	Climatology and Agrometeorology Research and Development Section
HTMIRDS	Hydrometeorology-Tropical Meteorology and Instruments Research and Development Section
NMS	Numerical Modeling Section
SSAS	Space Science and Astronomy Section
TPIS	Training and Public Information Section
PIU	Public Information Unit
CO	Central Office
PRSD	PAGASA Regional Services Division
NCRPRSD	National Capital Region PRSD
NLPRSD	Northern Luzon PRSD
SLPRSD	Southern Luzon PRSD

1. Outline of the Project

1. 1 Background

The Philippine archipelago, located near the western edge of the Pacific Ocean with population of 94 million people (based on the 2010 Census), is in the direct path of seasonal typhoons and monsoon rains which bring floods, storm surges, and their attendant landslides and other forms of devastation. According to Office of Civil Defense (OCD), 1,557 deaths and more than 3.5 million affected people were reported due to 12 tropical storms and typhoons which occurred in 2011. Every year, the Philippines seriously experience huge economic losses coupled with human anguish and sufferings generated by destructive tropical cyclones that cross the country. They have caused significant damage to agriculture which is a vital industry in the Philippines, thereby inflicting widespread poverty on its people. The extensive damage from tropical cyclones is a determining factor for the significant set-back of the national economy. They adversely affect the people's standard of living. To alleviate and proactively deal with the situations indicated above, establishment of effective countermeasures against natural disasters resulting from tropical cyclones is of pressing urgency.

The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) is the sole national meteorological service provider in the Philippines and is under the administrative supervision of the Department of Science and Technology. Its main responsibility as a National Meteorological Service is to record meteorological observations round the clock and to provide weather information, forecast, advisories and warnings necessary for the mitigation and prevention of natural disasters and improvement of socio-economic conditions.

In order to effectively protect life and property from tropical cyclone damage through establishment of a reliable and timely dissemination of public storm warning signal and tropical cyclone information to the public and disaster management agencies (e.g. OCD, The Philippine Coast Guard (PCG) and the local government units (LGUs)), the Government of the Philippines has requested the Government of Japan to implement "the Project for Improvement of the Meteorological Radar System" which includes the procurement and installation of the required equipment, construction of appropriate radar tower buildings, as well as provision of relevant systems and facilities, etc. under Japan's Grant Aid Assistance scheme (Grant Agreement signed on November 13th 2009). Three doppler radars have been established in Virac (Catanduanes Island), Aparri (Luzon Island) and Guiuan (Samar Island).

It is necessary that those procured equipment and installed systems are to be fully utilized for dissemination of the meteorological and disaster related information to the public and disaster management agencies. In order to strengthen the capacity to utilize the system and disseminate

the information, “the Project for Enhancing Capacity on Weather Observation, Forecasting and Warning” was requested by the Republic of Philippines.

1. 2 Outline

(1) Title of the Project

The Project for Enhancing Capacity on Weather Observation, Forecasting and Warning

(2) Project site

The target area of the project are PAGASA Central Office（Metro Manila）and Southern Luzon PRSD.

(3) Overall Goal

Capacity of all PAGASA Regional Services Divisions (hereinafter referred to as “PRSDs”) is enhanced in terms of weather observation, forecasting and warning.

(4) Project Purpose

Capacity of PAGASA Central Office and Southern Luzon PRSD is enhanced in terms of weather observation, forecasting and warning.

1-1 Average operation rate (i.e. data are provided to PAGASA from radars) of three radars becomes more than 80% in the third year.

1-2 Quantitative forecasting is issued by using weather guidance.

1-3 More than 80% of concerned actors (i.e. OCD; PCG; LGUs in pilot PRSD) agree that laymanized meteorological information is timely delivered to them in the third year.

(5) Outputs and Indicator

Output1: Capacity on weather observation is improved.

Indicator

1-1 Traceability of Instrument is improved through development of reference guides regarding maintenance and calibration.

1-2 Capability of more than 80% of staff engaged in the maintenance and calibration of SYNOP/ AWS stations and RADAR stations is enhanced.

1-3 Maintenance reports on respective equipment (i.e. RADARs, SYNOP stations and AWS) are regularly prepared and reported to the PAGASA Central Office.

Output2: Capacity on meteorological data analysis and forecasting is improved.

Indicator

2-1 Capability of 80% of the operational staff on the use of SATAID is improved.

2-2 Software for RADAR data calibration with rain gage data is developed.

2-3 Weather guidance is developed.

Output3: Criteria of warnings are elaborated at Southern Luzon PRSD.

Indicator

3-1 Criteria of warnings are made at the provincial level.

Output4: Content and accessibility of meteorological information are improved.

Indicator

4-1 Laymanized and professional information are differentiated at PAGASA's website.

4-2 Meteorological information is timely transmitted by PAGASA Central Office to concerned agencies particularly DRRMC

Output5: Activities of awareness-raising on meteorological information are improved at Southern Luzon PRSD.

Indicator

5-1 Action plan of awareness-raising is developed.

5-2 Result of the implementation of action plan is reported.

(6) Activities Outputs

Output1:

1.1 Monitor the operation of newly introduced three radars and identify issues in their operations.

1.2 Provide trainings for obtaining quality data from three radars including maintenance of facilities and equipment.

1.3 Develop a guideline and provide training on quality control of radar data.

1.4 Identify current status and issues on maintenance of AWS and SYNOP observatory at Southern Luzon PRSD.

1.5 Develop manuals and plans for calibration and maintenance, and inspection guideline of AWS and SYNOP observatory at Southern Luzon PRSD.

1.6 Provide training on calibration and maintenance based on the above plans at Central Office and Southern Luzon PRSD.

Output2:

2.1 Provide training on the operation of SATAID for viewing time-series weather information.

2.2 Develop software and provide training on methods to correct radar data by using surface observation data.

2.3 Provide training on weather guidance (Model Output Statistics).

Output3:

3.1 Conduct survey on current situation of warning and identify their challenges.

3.2 Elaborate methods to improve warnings and make criteria of warnings based on the above findings.

Output4:

4.1 Identify challenges on the content of meteorological information.

4.2 Improve the content of meteorological information to be more user-friendly.

4.3 Improve ways of information dissemination to the concerned agencies particularly DRRMC.

4.4 Improve the content of website at Central Office and Southern Luzon PRSD.

Output5:

5.1 Select pilot province(s) for awareness raising activities.

5.2 Assess local situation on the use of meteorological information.

5.3 Analyze causes of weather related disasters.

5.4 Identify challenges to enhance awareness of local population on weather related disasters.

5.5 Prepare materials for awareness raising activities.

5.6 Conduct awareness raising activities and collect local feedback on awareness raising activities.

(7) Counterpart Organization

PAGASA: Philippine Atmospheric, Geophysical and Astronomical Services Administration

(a) Project Director

Administrator will bear overall responsibility for administration of the Project.

(b) Project Manager

Weather Services Chief, Weather Division will bear overall responsibility for managerial matter of the Project.

(c) Assistant Project Manager

Chiefs, Southern Luzon and National Capital Region (NCR) PRSDs will support the activities of the Project Manager.

1. 3 Purpose

This project is implemented for PAGASA Central office and Southern Luzon PRSD offices (The target area of current project) to improve the following terms.

(1) Weather observation capacity

(2) Meteorological data analysis and forecasting capacity

(3) Warning criteria at the provincial level

(4) Content and accessibility of meteorological information capacity

(5) Awareness-raising on meteorological information activities in Southern Luzon PRSD

2. Enforcement Policy of the Project

2. 1 Basic policies

The project is implemented based on following policies.

(1) Mainstreaminig of disaster prevention (Transfer JMA technical skills)

Technical skills, which have been developed mainly by JMA through their experience, i.e. observation, forecast and data communication/ distribution skills under tight cooperation with related authorities and the public, will be transferred. Additionally, in order to meet PAGASA's requirements and situation, the project will be implemented while sharing information with JICA and PAGASA and taking a close contact with JMA (mainly the international affairs section in JMA).

(2) Technical cooperation along WMO policies

JMA and PAGASA are both NWSs (National Weather Services) of WMO, and both keep the frame work on the worldwide disaster prevention activities through sharing of observation and forecast data based on WMO's WWW (World Weather Watch) policy. As a RSMC (Regional Specialized Meteorological Centre) of Region II, JMA issues tropical storm warnings for Northwest Pacific area and this information is provided to PAGASA too. In addition, JMA is the RIC (Regional Instrument Center) of Region II and PAGASA is also the RIC of Region V. This project will be implemented based on these frame work and policy of WMO.

(3) Contribution to Northwest Pacific countries

Enhancement of observation skills and observation data quality of PAGASA would greatly contribute to Northwest Pacific countries for monitoring meteorological events needed to issue disaster prevention information through the provision of accurate observation data under the WWW framework. This project will contribute to enhancement of disaster prevention capacity, especially Typhoon in Northwest Pacific countries through sharing high accurate observation data.

(4) Technical transfer based on documents (Visualization of tasks)

This project will be implemented in mind of manuals and visualization such as making manuals of observation and forecasting, and the project output will be evaluated objectively. And regarding awareness raising activities) at Southern Luzon PRSD (hereinafter referred to as "SLPRSD"), planning documents, implementation documents and evaluation documents will be developed and will be used as example in next activity and/ or in other area.

(5) Ensure technical skills through review and improvement

In order to ensure technical skills, review and follow up of technical training will be the base of the training policy. The technical transfer and awareness raising activity will be conducted with the counterpart members. In mind of making the duty of the counterpart more and more, the counterpart

will carry on same activities itself in the future.

(6) Useful materials based on communication with users

Collaboration with LGU and school visiting lessons will be the purpose of the awareness raising activities, showing educational materials used in Japan. These materials are made/ developed using illustrations, like materials in Japan.

2. 2 Implementation method for each activity

(1) Domestic work (June to July, 2014) - Preparation for the project -

1-1 Data collection and survey for making work plan (Activity-1)

A work plan (W/P) will be made by reviewing previous reports of this project and related materials, and will update the concept to be modified by JICA and JMA. Moreover, manuals/ guidelines for observation, forecast and meteorological equipment inspection/ calibration will be collected. In addition, terms and methods will be prepared for the base line survey which is scheduled in August 2014.

1-2 Discussion on project basic policies and implementation methods (Activity-2)

From the collected materials of Activity-1, project basic policies and implementation plan will be constructed considering JMA recommendation.

1-3 Settlement of draft work plan (Activity-3)

A draft of W/P should be prepared including an initial technical and prescribe service requirements, project basic policies, activities methods, expert assignment, implementation structure, survey schedule, project area and related matters for completion of this project. Work flow of activities will be prepared upon consultation with counterparts (C/P), which is scheduled on July 2014.

(2) Local work (July 2014 to April 2017) - Activities in Philippines -

2-1 Consultation for the W/P (Activity-4)

The project team will discuss the mainstream of the W/P through consultation with C/P for implementation of this project with the following concepts: basic policies of the project, activity contents, working and staffing schedule, input from C/P, assignment of C/P staffs and related matters. Through the discussion on W/P the project team will obtain agreement with PAGASA regarding essential matters such as procurement equipment, assignment of experts and activity schedule.

Terms and methods for the baseline survey are shown in Appendix3 through explanation to C/P and record minutes of all meetings.

2-2 Baseline survey (Activity-5)

In order to analyze current status and issues for this project, a baseline survey will be

implemented under the following terms shown in Appendix3. The survey result will be documented and modify indicators of PDM by the end of September 2014. The results of survey will be summarized in 'Progress Report 1'.

(3) Output 1 Activities (Capacity on weather observation is improved)

3-1 Analyze current status and issues for new Radar operation (Activity-6)

The newly installed Radars have advanced features (easy maintenance and less trouble), however, electric generators have complex control units/ equipment and their maintenance might be more difficult to compare from conventional Radar systems. Continuous Radar observation in developing countries is difficult matter, and at first, continuous Radar operation and Radar data storage for more than 1 year must be aimed. Through the baseline survey, current status and issues of newly installed Radar operation and maintenance will be identified. Moreover, issues on maintenance, operation of Radar, Radar data quality and conservation of data will be identified through check of operation manuals and maintenance activities, and through hearing from Radar operation staffs. Issues should be improved and methods will be summarized including personnel resources and budget approval.

3-2 A draft of Radar maintenance manual (Activity-7)

Considering current status and issues obtained from Activity-6, a draft of Radar maintenance manual (including maintenance reports sheet) will be provided in order to obtain high quality Radar data stably.

3-3 Training for new Radar maintenance (Activity-8)

By using a draft of maintenance manual developed in Activity-7, the first training for Radar maintenance are scheduled on February 2015 in Virac and Aparri Radar site with 5 observation staffs for 5 days. 5 Guiuan Radar staffs will join the training which will be held in Virac or in Aparri. The second training will be scheduled on November 2015 in Virac Radar site with 5 observation staffs. A draft of maintenance manual will be updated based on the results of maintenance activities and trainings.

3-4 Radar data quality control guideline (Activity-9)

Weather Radar observes spatial distribution of rain and estimates spatial precipitation, however, observation data has errors/ noises caused by radio disturbance and interference by geographical features, sea clutter and other noises not accompanying precipitation. Radar observation data should be reanalyzed with observed precipitation data measured by rain gages. In order to keep Radar data quality in appropriate level, system troubles, radio disturbances, other noises at each Radar site in every season and in several precipitation types must be recorded separately. Based on historical observation records, quality control guidelines are created for Radar observation.

For Radar data quality control, a draft of Radar data quality control guideline will be made. After confirmation of JICA and PAGASA, the project team will revise the guideline.

3-5 Training for radar data quality control (Activity-10)

By using Radar data quality control guideline developed in Activity-9, training for Radar data quality control will be carried out on February 2015 in PAGASA Central Office with 5 representatives from weather forecast staffs for 6 days. In this training, 3 staffs from Virac, Aparri and Guiuan Radar site are invited to join. After the training, the guideline will be updated upon consultation with PAGASA staffs.

The 2nd training for Radar data quality control will be scheduled in September 2015 for 6 days with same participants. After these trainings, the guideline will be reviewed and revised.

3-6 Investigation for equipment at AWS/SYNOP observatories (Activity-11)

Based on the results of baseline survey, terms will be improved and methods for AWS/ SYNOP observatories will be evaluated.

3-7 'Inspection guideline' and 'Calibration and maintenance manual' (Activity-12)

Based on Activity-11, in order to maintain equipment properly at AWS/ SYNOP observatories, drafts of 'Inspection guideline' and 'Calibration and maintenance manual' will be provided.

3-8 Action plan for equipment maintenance at AWS/ SYNOP station (Activity-13)

Based on the abovementioned 2 manuals, an action plan for inspection, calibration and maintenance at AWS/ SYNOP observatories have been constructed.

3-9 Training for AWS/ SYNOP maintenance (Activity-14)

Based on Activity-12 and 13, the 1st training will be scheduled on February 2015 or October 2014 at PAGASA Central Office and at an observatory in SLPRSD for each 5 observation staffs for 2 days. On the 1st training schedule, 5 observation staffs from other PRSD observatories are invited to join. On that same period at PAGASA Central Office, training for inspection, calibration and maintenance will be held for RIC PAGASA staffs for 10 days. The 2nd training for will be held in October 2015 at PAGASA Central Office and at a SLPRSD observatory with 5 each observation staffs for 2 days.

3-10 Confirmation of maintenance activities with the maintenance manual at Radar sites (Activity-15)

Maintenance activities at Virac and Aparri Radar sites based on the Radar maintenance manual is to be confirmed, and the Radar maintenance situation will be evaluated compared from the concurrence of the project.

3-11 Confirmation of maintenance activities with the maintenance manuals at AWS/ SYNOP observatories (Activity-16)

Maintenance activities at AWS/ SYNOP observatories based on the Inspection guideline and the calibration and maintenance manual will be confirmed. The equipment and instruments maintenance situation will be evaluated comparing the situation at the beginning of the project.

Additionally recommendation for improvement of these activities and feedback of the manuals will be reported to PAGASA.

Examinations to evaluate skills of staffs, engaged in Radar and AWS/ SYNOP observation, will be performed by the beginning of 2nd training.

(4) Output 2 (Capacity on meteorological data analysis and forecasting is improved)

4-1 Training on the operation of SATAID (Activity-17)

Next generation Geostationary Meteorological Satellite 'Himawari' will be launched 2014 summer and the operation will start 2015 summer. Training for SATAID (Satellite Animation and Interactive Diagnosis) operation including usage of new satellite data is scheduled on 2015 autumn in PAGASA Central Office. In order to maximize training utility, current status and issues of daily SATAID operation will be evaluated and a schedule of the training with PAGASA and JMA will be planned. After these trainings, SATAID operation using new satellite data will be used in PAGASA daily operation.

4-2 Training on methods to correct Radar data by using surface observation data (Activity-18)

From Activity-6 to 13, a one year continuous Radar/ AWS observation and data storage (for analysis at least 1 month data will be required) will be implemented. Reliable observation data storage should be carried out.

Training on Radar data correction (correction method with using AWS data and relationship between precipitation and Radar data) is scheduled on February 2015 for 3 days. However, without actual Radar observation data the raining will be meaningless, so the training will be set in most appropriate time through consultation with PAGASA and JMA.

4-3 Training on weather guidance (Model Output Statistics) (Activity-19)

In order to make MOS (Model Output Statistics) guidance, historical observation data and NWP (Numerical Weather Prediction) data are required. Through the base line survey, following issues are necessary to be collected.

1. Historical observation data (elements, statistical values and record medium)
2. Historical NWP data (model type, elements, time interval, valid time and etc.)
3. Observation data and NWP data available for MOS guidance operation

Based on the baseline survey, forecasting area (stations) and elements (ex. temperature, precipitation, probability of heavy rain) will be identified upon consultation with PAGASA. Appropriate indices (ex. atmospheric stability indices) and relevant information regarding calculation and software codes will be identified.

After these preparation work, training materials for 1 to 3 days guidance and for 1 week guidance will be developed. In case of shortage of historical observation data, the way how to obtain data will be discussed with C/P. The activity consists of the following issues.

1. Development of MOS guidance
2. Evaluation with independent data
3. Consideration of parameters to improve accuracy
4. Confirmation and improvement of systematic error
5. Confirmation of matters for routine guidance operation
6. Other techniques for guidance (ex, Kalman filter technique)

The training in guidance for 3 staffs in PAGASA Central Office will be implemented 3 times (5days in November 2014, 5 days in May 2015 and 3 days in November 2015). The scope of training will be consulted with PAGASA and the project team for approval 1 month before of the training. In order to understand guidance, operational use of guidance and subjective evaluation are indispensable. So the training and homework will be designed for PAGASA staffs through discussion with PAGASA. And evaluation and investigation on guidance should be implemented by PAGASA itself.

(5) Output 3 activities (criteria of warnings are elaborated at Southern Luzon PRSD)

5-1 Conduct survey on current situation of warning and identify their challenges (Activity-3-1) (Activity-20)

Conduct survey and investigation on actual situation of warning issuance and its criteria at selected provinces in Southern Luzon PRSD. Gathering data information of documented records of casualties, damages on roads, bridges and other infrastructures are indispensable for appropriate warning criteria which happened during disasters in Philippines.

5-2 Elaborate methods to improve warnings and make criteria of warnings based on the findings (Activity-3-2) (Activity-21)

Through discussions with PAGASA and related authorities in Southern Luzon PRSD, the Consultant will prepare a draft for warning criteria with coordination of PAGASA staffs. The draft and warning criteria have been constructed considering coverage area of RADAR, available AWS stations, based on accurate forecasts coverage warning areas.

5-3 Trial operation of warning criteria and its improvement in Southern Luzon PRSD (Activity-22)

A test trial run on weather warning based on warning criteria shall be carried out for 1 rainy season and analytical steps to reach solutions. In case of segmentalization of forecasting area, congestion of forecasting should be considered and evaluation by related authorities will be monitored.

5-4 Operation of warning criteria in Southern Luzon PRSD (Activity-23)

An operation of warning criteria shall be implemented. Activities will be continuously monitored for further improvement and propose a plan for future activities of operation in SLPRSD for expansion.

(6) Output 4 activities (Content and accessibility of meteorological information are improved)

6-1 Identify challenges on the content of meteorological information (Activity-24)

Through the baseline survey, evaluation on the content of meteorological information issued by PAGASA Central Office and by SLPRSD offices will be identified.

6-2 Improve the content of meteorological information (Activity-25)

Meteorological information contents in comprehensive expression upon consultation and confirmation with PAGASA. This information will be designed for people to easily understand, i.e. with using visualization technique and concise expression.

6-3 Improve ways of information dissemination to the concerned agencies particularly DRRMC (Activity-26)

Current status and issues regarding communication schemes of weather information through e-mail, fax, phone-call, SMS to other authorities (especially NDRRMC and LGUs) will be analyzed through baseline survey. Terms of survey is as follows.

1. Contents, methods, frequency and timing of information to NDRRMC and LGUs
2. Evaluation and request of improvement for weather information by users
3. Information communication scheme, its structure and regulation

In order to investigate how people obtain meteorological information and what kind of communication tools they use, previous survey reports will be reviewed through consultation with PAGASA, related authorities and mass media. By using these reviews or reports (Japanese reports can be used as reference), a questionnaire will be prepared for interview activity in SLPRSD. Based on interview reports, terms and methods for improvement will be consult and confirmed with PAGASA regarding communication schemes of meteorological information.

Upon implementation of improvement activities, its process, methods and feedback results to activity reports will be recorded.

6-4 Improve the content of website at Central Office and Southern Luzon PRSD (Activity-27)

PAGASA website has the same information pages for PAGASA officials and public web users and due to the confusion of users. Additionally response of website connection is quite slow.

Typical internet website manager (ex. Apache) keeps data log regarding accesses from users and useful free software to analyze such access is provided on the Inter-Net (Google analysis, web analyzer and other provider).

The project team will propose some procedures and design appropriate capacity for web servers, in order to separate the website for internal use of PAGASA and for public users. The website analysis will be implemented upon confirmation and acceptance of PAGASA.

1. Access log setting is indispensable in PAGASA website Analysis software and access logs in servers are used to record the number of hits of each page and who access to these page from outside and inside of PAGASA
2. Make popular page list for people based on number of hits
3. Design web pages for internal use
4. Make improvement plan of new Website for PAGASA officials and for public users.
5. NDRRMC and LGUs comments and feedback on website
6. Design improvement plan of Website

The project team recommend to separating the communication lines and website address for public users and PAGASA officials. Regarding this matter, improvement plan of website shall be consulted with PAGASA and shall be evaluated by NDRRMC and LGUs, and will be recorded for future improvement activity.

(7) Output 5 activities (Activities of awareness-raising on meteorological information are improved at Southern Luzon PRSD area)

7-1 Select pilot province(s) for awareness raising activities (Activity-28)

By the end of baseline survey, pilot provinces will be selected for awareness-raising activity in SLPRSD upon confirmation with PAGASA and JICA.

7-2 Assess local situation on the use of meteorological information (Activity-29)

The terms and methods from selected provinces on actual situation regarding meteorological information usage will be investigated through discussion with LGUs and local disaster prevention committee. In JMA case, time sequence record of meteorological information issuance was analyzed.

7-3 Analyze causes of weather related disasters (Activity-30)

JMA started 'Immediate Field Investigation' from 2001 to analyze causes of weather related disasters. When a natural disaster occurs, local staffs of JMA observatory visit disaster affected area with cooperation of local governments and issues 'Immediate Field Investigation report'. (A. Okubo et al.; Prompt report and on site research after natural disaster, Tenki 50(10), 803-806, 2003)

The main purpose of JMA activities are:

1. Human damaged disaster
2. Disaster played up by mass media
3. Disaster investigated by disaster related organization

In order to analyze causes of weather related disasters in SLPRSD, cooperation research (analysis) of causes will be implemented based on historical disasters from points of view to reduce disasters upon using meteorological information issued by PAGASA.

A trial implementation in disaster site reference to JMA activities with a same kind of immediate field investigation. In Addition, time sequence of warning issue and meteorological factors nearby affected area will be recorded.

7-4 Identify challenges to enhance awareness of local population on weather related disasters (Activity-31)

Through the baseline survey, current status of awareness-raising activities in SLPRSD will be analyzed and evaluated. According to newspapers, severe damages have caused because of less understanding about storm surge during typhoon 'Yolanda', this serious situation have been carefully investigated due to the comments from the people especially from the affected areas.

7-5 Prepare materials for awareness raising activities (Activity-32)

Gathering of awareness-raising activity materials in Japan, in other countries and in the Philippines, awareness-raising materials are prepared for local disaster prevention committees and junior schools.

7-6 Conduct awareness raising activities and collect local feedback on awareness raising activities (Activity-33)

To implement awareness-raising activity, the following terms will be noted:

1. Prepare documents and record procedures (planning, materials, scenario, figures and etc.)
2. Review activities and record good and bad points of activities for improvement of plans
3. Based on review, improve activity plans and materials

In reference to the awareness-raising materials using in Japan, the project team suggests using similar awareness-raising materials for awareness-raising activities which is more concise and users friendly. Copyrights of materials shall belong to PAGASA.

(8) Seminars and a training in Japan

8-1 Seminars (Activity-39)

The project team shall make a provision to undergo 3 seminars (shown in table 2-1) for announcing the meteorological observation and weather forecasting activities carried out in PAGASA Central Office and SLPRSD. These seminars also include a special session/lecture by Japanese experts and/ or a panel discussion for disaster prevention activities between C/P and Japanese experts. On the basic plan on July 2014, a Japanese speaker (expert) will be invited for the 1st and 3rd seminar. Programs, speakers, venues and other related matters will be discussed closely among PAGASA, JICA and the project team.

Table 2-1 Seminars

	Date	Theme
1st	November, 2014	Storm surge caused by typhoons
2nd	July, 2015	Disaster prevention activities at local communities
3rd	March, 2017	Weather information to reduce natural disaster risks

2. 3 Changes of implementation plan

Based on the discussion with the counterpart, PAGASA, changes of implementation plan are proposed and agreed with JICA for better accomplishment of the project. These changes are recorded on letter of agreement with JICA. The changes of implementation plan since Feb. 2015 are shown below.

(1) Changes of procurement plan of the equipment (Letter of agreement on 16 Feb. 2015)

As a result of discussion with C/P on use, specifications, and quantity of equipment such as PC, OA equipment in the initial procurement plan listed in the project specifications, 1,932,342 JPY in total, were modified. They are listed in the following table, e.g., a high speed PC with large external storage for use in Radar observation and weather forecast. PCs for use in awareness-raising activities were chosen from laptop type PC due to its portability. For improving stability and security of C/P network system, switching hub and virus protection software were also added to the list.

1-1 Equipment, quantity, and estimated price listed in the project specifications

Equipment	Quantity	Unit price (JPY)	Total price (JPY)	Comment
Desktop PC	5	250,000	1,250,000	
Scanner-Printer Compound Apparatus	1	349,980	349,980	
Projector	1	252,362	252,362	
Projector Screen	1	80,000	80,000	
Total			1,932,342	

1-2 Modified equipment list based on discussion with C/P

Equipment	Quantity	Unit price(JPY)	Total price (JPY)	Comment
Desktop PC	1	600,000	600,000	*1
Desktop PC	1	123,979	123,979	*3
Laptop PC	2	175,000	350,000	*1

External storage	1	18,000	18,000	*2
Hard Disk Drive(4TB)	5	18,000	90,000	*2
Switching Hub	1	4,000	4,000	*3
Virus protect software	3	5,500	16,500	*1
Projector	1	200,000	200,000	*2
Screen for Projector	1	80,000	80,000	*2
Scanner-Printer Compound Apparatus	1	447,492	447,492	*4
Total			1,929,971	

*1, *2 : Being prepared

*3, *4 : Purchased

(2) Changes of procurement list of the equipment (Letter of agreement on 27 Feb. 2015)

As a result of baseline inspection, it became clear that PAGASA has already installed liquid chamber system that has similar specifications to the initial procurement plan shown below. On the other hand, reference barometer and calibrating apparatus for barometer were not well installed in PAGASA, although digital barometer was already introduced into each meteorological station.

Based on this inspection and with the guidance of the observation department of JMA and RIC Tsukuba, the equipment list was changed (2,350,000 JPY in total) as follows.

2-1 Equipment, quantity, and estimated price listed in the project specifications

Equipment	Quantity	Unit price(JPY)	Total price(JPY)	Comment
Pressure regulator	1	300,000	300,000	
Pipe work and Jigs	1	1,200,000	1,200,000	
Liquid chamber	1	750,000	750,000	
Summary			2,250,000	

2-2 Modified equipment list based on discussion with C/P

Equipment	Quantity	Unit price(JPY)	Total price(JPY)	Comment
Pressure regulator	1	300,000	300,000	
Pipe work and Jigs	1	1,200,000	1,200,000	
Pressure chamber	1	750,000	750,000	
Summary			2,250,000	

(3) Change of assigned person in charge (Letter of agreement on 10 April 2015)

3-1 Extension of the term of assignment

Concerning Outputs 1-a, 2-b, and 5-b, the terms of assignment were changed for the following reasons.

・Output 1-a（Radar observation）

Based on the baseline inspection and investigation of Radar sites by short-term experts, many technical issues, such as slacks in mechanical part of Radar main body system, troubles in generator and UPS, and alert indicator of the system, were found. Under these situations, the practice of technical training was considered to be difficult. For this reason, the original plan to practice one week of maintenance training at each Radar sites was modified to allocate a period of half a month for preparation of training environment in order to regulate flaws of Radar system before the training. Thus assignment of 1.00MM (0.5 MM x 2) was added to the assignment of Output 1-a.

Assignment before change　3.00MM　→　Assignment after change　4.00MM

・Output 2-b（Meteorological Guidance）

The initial plan to execute forecast guidance training based on MOS method was completed as planned. However, evaluation of forecast accuracy showed that this method would not give a required accuracy due to large bias errors. On the other hand, the preliminary test using Karman filter method showed a better result compared with the result of MOS method and would be suitable for use in operational forecast.

As C/P expected to introduce this method into operational forecast based on this evaluation result, it was required to add assignment of 3.00 MM to the initial assignment of 3.00 MM in order to introduce this method.

Assignment before change　3.00MM　→　Assignment after change　6.00MM

・Output 5-b（Awareness raising）

For putting awareness activities at elementary schools in the pilot area into practice, discussion was made with C/P and organizations related to DRR. It became clear that (1) support from department of education (DepEd) at the pilot area is essentially important and (2) PAGASA also hope to straighten the relation with DepEd. In order to practice awareness activities under the support of DepEd in the future, it is needed to explain the contents and scenario of awareness-raising practice and to get a permission and support from DepEd at least one month before the practice. For this reason, it was required to add assignment of 1.00 MM (0.50 MM x 2 times).

Assignment before change　4.50MM　→　Assignment after change　5.50MM

3-2 Reduction of the terms of assignment

Concerning Outputs 4 and 5-a, the terms of assignment were changed for the following reasons.

・Output 4（Meteorological information）

The main focuses of this output are (1) separation of the browser of PAGASA Website into intranet user and public and (2) establishment of stable and secure communication medium of meteorological information. Based on the baseline investigation, it was recognized that (1) revision of Website is relatively difficult because PAGASA Website is installed and managed in the different administrative department, DOST, (2) PAGASA also outsources the Website design and (3) separation of the Website is already pushed forward by PAGASA. Thus, our main focus was slightly shifted from revision of Website to consultation and advice for the improvement of meteorological information from Website by PAGASA. In addition, for establishing comprehensive meteorological information and reliable communication, examination of utilization of SNS and so on is to be carried out together with the improvement of PAGASA Website information.

Assignment before change　12.83MM　→　Assignment after change　9.83MM

・Output 5-a（Awareness raising）

It is thought that collaboration with Output 5-b member is very effective for briefing of awareness raising at the sites, because awareness seminars at pilot areas have been held in collaboration with Output 5-b group. From this, the initial goal of Output 5 will be accomplished even if assignment of Output 5-b member is reduced from 12.00 MM to 10.00 MM. Even if the assignment is reduced, the task of management of the project will not be interfered in considering adjustment of visiting schedule with the sub project manager.

Assignment before change　12.00MM　→　Assignment after change　10.00MM

(4) Changes of procurement list of the equipment (Letter of agreement on 7 July 2015)

Based on the discussion with C/P, OA equipment was changed in the procurement plan listed in the special specifications, 1,932,342 JPY in total, as follows.

4-1 Equipment and its quantity before and after alternation

・Equipment List（before the changes）(planned in Letter of agreement on 16 Feb. 2015）

Equipment	Quantity	Comment
Desktop PC	1	
Desktop PC	1	
Laptop PC	2	
External Storage Unit	1	

Hard Disk Drive(4TB)	5	
Switching Hub	1	
Virus Protection Software	3	
Projector	1	
Projector Screen	1	
Scanner-Printer Compound Apparatus	1	
Total		1,932,342 JPY

・Equipment List re-proposed by discussion with C/P（revised）

Equipment	Quantity	Comment
Desktop PC	1	(Purchased)
Desktop PC	1	(Purchased)
Laptop PC	1	One Laptop PC → 2 Laptop PC
Color Printer	2	Added to the list
Graphic Software	1	Added to the list
External Storage Unit	1	(Purchased)
Hard Disk Drive(4TB)	5	(Purchased)
Switching Hub	0	Deleted
Virus Protection Software	3	（One software is purchased）
Projector	1	(Purchased)
Projector Screen	2	One screen → 2 screens
Scanner-Printer Compound Apparatus	1	(Purchased)
Total		1,932,342 JPY

(5) Change of project officer (Letter of agreement on 31 July 2015)

The project officer of Radar operation and maintenance for the work of baseline inspection and operation manual was assigned to Mr. Hiroshi Yamaguchi. For future technical guidance at Radar sites, Mr. Masaru Wakabayashi, who has a lot of experience in technical guidance and training on Radar maintenance at Cambodia and so on, was assigned in place of Mr. Yamaguchi.

(6) Change of project officer (Letter of agreement on 17 November 2015)

In 2016 Feb., Radar operation and maintenance training for PAGASA radar operator is planned in Virac Radar site. For the understanding of the detail mechanism of JRC Radar, it is necessary to assign a lecturer with high knowledge and experience on the radar technology. For this reason, Mr. Masahiro Nagashima, who is a specialist of Radar technology, is added to the assign members and, for the

accomplishment of the training manual, Mr. Wakabayashi and Mr. Nagashima is to assign to write the hardware part and the software part of the training manual, respectively.

Assigned Member

- Radar operation and maintenance (hardware) Masaru Wakabayashi
- Radar operation and maintenance (software) Masahiro Nagashima (added)

(A) Assignment before change

- Masaru Wakabayashi Nov. 2015 to June 2017 (79 days)

(B) Assignment after change

- Masaru Wakabayashi Nov. 2015 to June 2017 (71 days, minus 8 days)
- Masahiro Nagashima Nov. 2015 to Dec. 2015 (8 days, plus 8 days)

(7) Change of project officer (Letter of agreement on 25 December 2015)

The issue of the Progress Report 2 is required to harmonize with JCC Minuets of the Meeting. However, the 4th JCC, which was expected to hold in the end of Nov. 2015, was postponed to 28 Jan. 2016. For this circumstance, the deadline of the issue of the Progress report 2 was postponed to the end of Jan. 2016 from the middle of Oct. 2015.

(8) Accomplishment Report on J-POW Training in Japan 2015 (Letter of agreement on 28 December 2015)

On this occasion of one and half years has passed since J-POW project started, J-POW Training in Japan was planned and implemented to the J-POW members as a part of the support for capacity development of PAGASA stuff. The purpose of this training is to deepen the understanding on the meteorological service of Japan, especially for disaster meteorology business, and to contribute to smooth implementation and promotion of J-POW project.

1) Training Period 12 to 24 October 2015
2) Members 4 staff from PAGASA (see Appendix in 2-3)
3) Goal of this Training
   (1) To understand the role and the business of Japanese National Weather Service in weather disaster prevention service in Japan.
   (2) To understand the outline of the numerical weather forecast technology in Japan.
   (3) To get a technical understanding of weather guidance, Radar data technology such as QPE and QPF, and the software environment for Meteorological Satellite visualization and manipulation of satellite imagery, NWP products, observation results and data (SATAID).

Note: The schedule, curriculum, member list, and evaluation are shown in the Appendix 5.

(9) Change of project officer (Letter of agreement on 25 March 2016)

For enhancing the capacity of weather forecast and warning, it is necessary to perform the calibration of the radar precipitation using a rain gauge data, which will be capable of getting horizontal distribution of quantitative precipitation rate. However, realtime rain gauge data is lacking in the Southern Luzon PRSD. For this reason, in order to use for calibration of Radar precipitation analysis in Output 2 and to contribute to strengthen the capacity of warning information in this region, construction of automatic rain gauge network (ARG network) was decided.

For this purpose, the assign period of Mr. Michihiko Tonouchi is added to 0.47MM and the contract amount will be increased 9,424,080 JPY. The Project Specification is changed as follows.

(10) Change of project officer (Letter of agreement on 31 August 2016)

Due to health issue of Ms. Shizuko Komatsu (Rating Grade-4), she cannot be no longer able to continue the assigned task. For this reason, the assign of Ms. Komatsu is replaced to Ms. Ikuko Inoue (Rating Grade-4).

(11) Change of business trip schedule (Letter of agreement on 31 August 2016)

Due to a requirement from the other JICA program at Dubai, Dr. Masao Mikami, sub Project Manager, is to stay Dubai for invited presentation at the workshop of the other JICA project in Dubai from 25 to 27 Sep. 2016. For attending this workshop, the business trip schedule in Philippines, Sep. 8 to Oct. 19, 2016, was adjusted.

(12) Change of business trip schedule (Letter of agreement on 17 April 2017)

At the 7th JCC held on April 21, it is necessary to obtain approval from PAGASA for the product of this project, the deadline for submitting the project completion report from April 21 to May 31.

3. Result of the Activity

3. 1 Output1-a (Capacity on weather observation is improved)

3. 1. 1 Project Purpose

(1) Outputs and Objectively Verifiable Indicators

[Output] 1 Capacity on weather observation is improved.

[Indicator] 1-1 Traceability of Instrument is improved through development of reference guides regarding maintenance and calibration.

1-2 Capability of more than 80% of staff engaged in the maintenance and calibration of SYNOP/ AWS stations and RADAR stations is enhanced.

1-3 Maintenance reports on respective equipment (i.e. radars, synop stations and AWS) are regularly produced and reported to the PAGASA Central Office.

(2) Activities

1-1 Monitor the operation of newly introduced three radars and identify issues in their operations.

1-2 Provide training for obtaining quality data from three radars including maintenance of facilities and equipment.

1-3 Develop a guideline and provide training on quality control of radar data.

3. 1. 2 Issues identified in the baseline survey

The baseline survey was implemented at three (3) new radar sites (Aparri, Guiuan and Virac). Following issues were identified through the baseline survey.

(1) Regular maintenance

Positive indications	The operation manuals, maintenance manuals, troubleshooting manuals, regular maintenance sheet/book (Daily, Weekly, Monthly, Semi-annual and Annual) and other documents which were provided by JRC (Japan Radio Company: Supplier of the radar) were delivered in all radar sites and they are utilized very well. Two well-trained operators were assigned at Aparri radar site and they implement regular inspection/maintenance steadily based on the manuals.
Challenges	Two operators assigned at Virac radar site were not trained well. Since the CMO of Virac site has to implement a radar maintenance himself, it is difficult to assure that the regular maintenance, such as Daily inspection and other regular inspections, is implemented regularly.

Cause and analysis	As mentioned above, the materials were delivered at each radar site, they were utilized very well at Aparri radar site. The implementation of the inspection is charged to the site, and it seemed that they have a superficial understanding that regular inspections are essential to a stable radar operation.
Counter-measure	[Organizational aspects] A series of the procedures on the inspection, such as implementation of inspection, submission and approval, will be stipulated in a document. -> Radar maintenance manual The acknowledgers will be assigned at PRSD and CO, and if the report is not submitted, the acknowledger has to urge to the site. [Human resources aspects] A radar maintenance training should be conducted periodically in order to develop skills and raise the awareness of radar operators.

(2) Technical transfer between radar operators

Positive indications	PAGASA dispatches many engineers to the radar raining conducted in not only in the Philippines but also overseas and develops human resources.
Challenges	As mentioned above, two operators were assigned at Virac radar site, but it is needed to train them about a new radar system. Thus the CMO has to perform a radar maintenance himself.
Cause and analysis	At the personnel relocation, it seems that the technical transfer for new staff was not conducted intentionally. The cause is supposed that there are no manuals for the technical transfer and it is not the custom to share knowledge and skills with other personnel. There are many engineers who had radar operation skills in PAGASA, but it is an actual situation that a greater part of them is working in other sections.
Counter-measure	[Organizational aspects] The materials which are needed for the technical transfer should be prepared. It is necessary to consider that the well-trained radar technicians will continue to work at a radar site for a certain period and train a younger generation. [Human resources aspects] It is needed to develop human resources and improve skills of radar operators through the periodical internal training.

(3) Observation skill at station level

Challenges	Some failures were found out at Virac radar site, such as a fuel leak of generators, dead battery of a generator and dead batteries of UPSs. The incident report was already submitted to CO through the PRSD, but the repair and replacement were not implemented yet.
Cause and analysis	It is pointed out that the standard procedure is not established when a failure happened. It was heard that one site informed to CO directly by phone and another site informed to PRSD. In the case of Virac radar site, they informed to CO through PRSD. But a countermeasure was not taken and it was not known that in which level the incident report was stuck.
Counter-measure	[Organizational aspects] It is needed to develop a procedure/manual which sets up the rule of submission and approval of the incident report when failures happened. Since it is possible to estimate regular replacements, it is better to keep a budget for them aforetime. [Human resources aspects] It is needed to clarify the procedures in the case of failure through the periodical internal training.

(4) Lack of radar operator

Challenges	There were two radar operators in each radar site. In consideration of 24 hours/365 days operation, it is better to increase the number of the operator.
Cause and analysis	The present number of the operator is assumed a day shift and not assumed a night shift. It is necessary to establish a basic policy on a management of the radar.
Counter-measure	[Organizational aspects] It is necessary to establish a basic policy on a management of the radar. Two options are supposed. - Resident operators for 24 hours by shift working - Day shift only and night response is considered separately In the latter case, it is necessary to consider the following matters. - Monitoring radar condition at CO for 24 hours - Response in the night time - Assignment of operator and/or outsourcing in the night time

	[Human resources aspects] It is needed to develop human resources and improve skills of radar operators through the periodical internal training.

3. 1. 3 Outline and outcomes of activities

(1) Outline of activities

Consultants implemented a Base Line Survey at Aparri, Guiuan and Virac (sites where JRC radar managed) regarding radar maintenance activities, radar maintenance records, its frequencies, quality of radar product, storage of radar data and manuals in August and November 2014. Based on the base line survey, consultants proposed drafts of 'radar maintenance manual' and 'radar data quality control manual'.

In February 2015, Mr. Wakabayashi, as a JMA short term expert, implemented 2nd base line survey at Aparri, Guiuan and Virac, and additionally provided lectures for radar maintenance and basic maintenance OJT (On-the-Job-Training). Through the survey, PAGASA implemented regular maintenance steadily and performance test was implemented at Aparri, however, performance test at Virac and reporting for trouble shooting were not implemented (should be reported). Thus, consultant team thought that 'radar senior engineering for advance management of radar' should be prepared. In order to prepare and implement 'radar senior engineering training', the radar expert was changed from Mr. Yamaguchi to Mr. Wakabayashi. Mr. Wakabayashi was to survey maintenance activities and prepare senior radar engineer training.

In November to December 2015, Mr. Wakabayashi implemented review survey regarding radar maintenance, commercial electricity investigation and did radar maintenance follow-up training. During the period, in order to survey radar data processing and quality control procedure, Mr. Nagashima, an expert of radar software, implemented a survey at Virac and the PAGASA headquarters.

(2) Outcomes of activities

[August and November 2014]

The J-POW project team visited the ETSD (Engineering and Technical Service Division), which is in charge of the radar maintenance in PAGASA, in order to investigate the current status of the manuals of the new radars, the radar maintenance log records and the management records of the radar site. At the same time the J-POW tem visited the three new radar sites in order to make a survey on the current status of the manuals of the new radars, the radar maintenance log records.

Table 3-1-1 List of Meeting and Interview

Date	Attendee	Contents
7 August	ETSD	- Survey on manuals and other documents of the new radar - Browsing the manuals and inspection books
13 to 14 August	OIC and operators, Aparri Radar Site	Site survey on; - Assignment of personnel and technical level - Equipment and facilities - Maintenance and inspection - Manuals and inspection books - Utilization of manuals - Data quality control and storage
18 to 19 August	OIC and operators, Guiuan Radar Site	Site survey on; - Assignment of personnel and technical level - Equipment and facilities - Maintenance and inspection - Manuals and inspection books - Utilization of manuals - Data quality control and storage
27 to 28 August	OIC and operators, Virac Radar Site	Site survey on; - Assignment of personnel and technical level - Equipment and facilities - Maintenance and inspection - Manuals and inspection books - Utilization of manuals - Data quality control and storage
24 to 27 October	ETSD	Survey on; - Data storage condition (Type and period) - Data storage server - Radar data download and analysis
28 to 30 October	ETSD	Scrutinization of manuals

[February 2015]

Mr. Wakabayashi, as a JMA expert, implemented a survey for radar maintenance and provided lectures and exercises on radar (equipment) maintenance (Table 3-1-2) at Aparri, Virac and Guiuan from 10 to 27 February 2015. Training on trouble shooting of radar had not been implemented because of shortage of activity assignment.

Aparri radar site (radar and building) was well maintained and daily regular maintenance was implemented, however, radar performance check was not implemented. Commercial power electricity shortage often happened, hence electric generator was operated so often to recover the power. At Virac, stable radar operation was implemented, however, the operation depended on a chief engineer personal skills and experiences. At Virac commercial power electricity was very unstable, and there were troubles on UPSs and it also affected stable radar operation. The consultant confirmed that matters, (i) UPS troubles, (ii) educate new generation radar engineers and (iii) make power electricity stable, should be sorted out. Additionally, the exit door of radome could not be closed because of rusts. If the door was not repaired, the radome might be broken like Guiuan during strong wind events (urgent repair should be implemented).

Table 3-1-2 Training for radar site maintenance

date	site	Trainees	Contents
12 Feb. 2015	Aparri	6 radar engineers	Radar maintenance, quality check of radar data
16 Feb. 2015	Virac	7 radar engineers	Radar maintenance, quality check of radar data
20 Feb. 2015	Manila	20 radar engineers and forecasters	Radar maintenance, quality check of radar data
24 Feb. 2015	Guiuan	10 radar engineers	Radar maintenance, quality check of radar data

[November to December 2015]

Mr. Wakabayashi implemented a review survey (includes short training for radar maintenance) in order to assess radar maintenance activities, check commercial power electricity, and interview the radar engineers in preparation for the radar senior engineer training. During the survey, he implemented training for radar maintenance at Virac, for radar product usage at Aparri and for supporting PAGASA trainers for students lecture. At 3 sites, he implemented commercial power electricity survey, and found that power electricity was stable in this season (November to December).

The result of the review survey in December 2015 is shown below in Table 3-1-3.

Table 3-1-3 Matters at each radar site (at December 2015)

site	Situation
Virac	Commercial electric power in December was stable during the survey period. However, according to the power generator operation records, power shortage frequently occurred in summer season. For sustainable radar operation, it is indispensable to ensure stable commercial electric power. Reports on regular maintenance and power generator operation were recorded, but trouble shooting reports were not prepared and submitted. PA (Power Amplifier, replaced with a spare PA in February 2015) had troubles again, so investigation for this PA is required.

	The exit door of radome did not close properly because of rusts at door junctions. It should be repaired as soon as possible.
Aparri	Power electric company was changing a fuse breaker. Electric power was stable in December. Radar operation with commercial electric power was suspended due to condenser problems on UPS. Daily maintenance and performance check were regularly implemented. Equipment is used properly under initial setting. For extended usage, additional training is required. The joints of exit door from radome had rusts and it was difficult to close the door. After removing rusts, consultant requested staff to re-paint the joints. A few fixing pins of earth line from lightning conductor to ground were stripped away.
Guiuan	Commercial electric power was unstable, thus its stability should be ensured as soon as possible. Consultant reported power electricity fluctuations to radar engineer for consultation with power electric company. Consultant handed a requirement paper for senior radar engineer training and questions for JRC radar to Guiuan radar staff and asked him to forward them to JRC.

[February to March 2016]

Based on the above survey results, Consultants conducted a senior radar engineer training at Virac radar site from 15 February to 13 March 2016. The outline of the training is given below in Table 3-1-4.

Table 3-1-4 Outline of the Senior Radar Engineer Training at Virac

Date	Contents	Attendee
Monday 15 February 2016	Consultants arrived at Virac around 11:00. Following an opening by Mr. Garucia, Director, Southern Luzon PRSD, the details of the training program were briefed to the participants, followed by a paper test of electronic circuit.	Aparri: Antonio Pagalilaua Karcher Valoria Guiuan: Domingo Cabaging Virac: Juant Pantion, Jr Ronito Rodulfo April Joy T. Trante
Tuesday 16 February	Lecture to a total of six participants (2 from Appari, 1 from Guiuan, and 3 from Virac radar sites) on: electronic circuit; radar terminology; and basic principles of weather radar systems and possible causes of troubles (e.g., groups of	- ditto -

	insects and birds, bright band, etc.)	
Wednesday 17 February	Review of the previous day's lecture, followed by lecture on: radar equation; physical mathematics relating to radar technology, with practice/exercise; and principles of rainfall measurement	- ditto -
Thursday 18 February	Review of the previous day's lecture, followed by lecture on: calculation of rainfall amount from Z, ZdB, ZdBm based on the radar equation; difference between analog and digital signals; and Doppler radar system	- ditto -
Friday 19 February	Review of some radar-specific terms, followed by troubleshooting of a time synchronization problem (lecture subjects were changed, due to power failure until around 16:00)	- ditto -
Monday 22 February	Lecture on Doppler radar system and products; On-the-Job-Training (OJT) on radar operation by two groups, Appari and Virac teams, following procedures for switching off (ending the operation) and switching on (starting the operation), respectively; and practice in radar operation with Q&A on JRC Manual	- ditto -
Tuesday 23 February	Review of the radar operation, through OJT of operation procedures by different teams (by swapping roles) followed by UPS battery operation test; and practice on visualization of radar products	- ditto -
Wednesday 24 February	System operation test, with UPS backup and without all commercial electric power; check of warning message at radar room (Note: Virac radar site was renovated after last visit in February 2015, with improvement in daily report, maintenance log report, and data archive.)	- ditto -
Thursday 25 February	Review of system operation test under all commercial electric power-off, with emphasis on the importance of UPS backup; review of unavailability of remote log-in during troubleshooting of a time synchronization; and troubleshooting of warning message	- ditto -
Friday 26 February	Travel to Manila for Visa extension arrangements; and preparation of training materials at PAGASA office	
Sunday 28 February	Travel back to Virac	
Monday	OJT on regular system maintenance, including antenna	- ditto -

29 February	positioning [measurement of antenna EL positioning angle error (max. 0.7 degrees found)]	
Tuesday 1 March	OJT on radar transmitter: measurement of pulse-width, PRF and transmission power	- ditto -
Wednesday 2 March	OJT on radar transmitter: measurement of pulse-width, PRF and transmission power (continued)	- ditto -
Thursday 3 March	- ditto -	- ditto -
Friday 4 March	OJT on Digital Receiver and Signal Processor (DRSP)	- ditto -
Monday 7 March	AVR cutting-test to evaluate Capacitator UPS; check/test of receiver unit (Smin. and dynamic range); and OJT on compressor device	- ditto -
Tuesday 8 March	Practice on antenna AZ angle error measurement; troubleshooting of compressor; and precision check of antenna AZ angle	- ditto -
Wednesday 9 March	Power cut-off test in four cases; confirmation of solved/improved compressor trouble; checking of spare parts and tools; and lecture on principles of receiving system, meaning of dynamic range, impact on precipitation estimation, and assumed causes	- ditto -
Thursday 10 March	Lecture on technical terms (which were not covered during the training period); free discussion on defects/troubles occurred during the training period; and review of outstanding issues	- ditto -
Friday 11 March	Practical examination on the operation of transmitter and receiver unit, followed by the award of certificates and closing	- ditto -

[May to June 2016]

Further to the training in Virac mentioned above, a follow-up training was conducted for senior engineers at each radar site (i.e., Virac, Appari and Guian). The training period and number of participants are given below:

(a) Virac radar site: 23-26 May 2016 (2-7 participants)
(b) Appari radar site: 30 May-3 June (10 participants)
(c) Guian radar site: 7-9 June 2016 (7 participants)

The outline of the training is as follows:

Table 3-1-5 Training for senior radar engineers

Date (2016)	Title	Venue	Attendees
22 May	Travel from Manila to Virac	Virac	2
23 May	Pre-training meeting and review of JRC responses to questions	Virac	2
24 May	Practical examination on the outcomes of the previous training, followed by visual inspection of receiver unit.	Virac	6
25 May	Transfer of the maintenance skill to other staff by trained staff; visual and audiological inspection of antenna operation, Q&A session on maintenance; abnormal data check, review of trouble reports, visualization of EG operation reports	Virac	7
25-26 May	Practical training on replacement of devices in case of transmitter/receiver troubles; visual inspection of receiving unit and antenna control unit; and lecture on basic LINUX	Virac	7
30 May	Travel to Appari	Aparri	2
31 May	Lecture on: utilization of radar data; principles of Doppler radar for rainfall intensity and Doppler wind; example of abnormal data	Aparri	10
1 June	Visual inspection of main devices and cleaning	Aparri	10
2 June	Visual inspection of antenna control unit; demonstration of biannual maintenance (partly); troubleshooting of EG control panel	Aparri	10
3 June	Troubleshooting of EG control panel (identification of cause, repair by replacing micro SW)	Aparri	5
7 June	Pre-training meeting and information sharing on defects and troubles revealed at Virac and Appari; practical examination on the maintenance of transmitter/receiving unit; and lecture on principle of Doppler weather radar	Guiuan	7
8 June	Repair of backup UPS; monthly and biannual maintenance (antenna control); performance check of transmitter)	Guiuan	4
9 June	Performance check of receiver unit; wrap up of the training; and discussions on outstanding issues related to operation and maintenance of weather radar	Guiuan	7

(3) Outcomes

The outcomes of this output are as follows.

[Radar Maintenance Manual (52 pages)]

Since the transmitter of the new radar is a solid-state type, as it is different from a conventional 'magnetron' type, the failure of the radar gets less against the conventional radar. On the other hand,

the new radar sites were located in the very bad circumstance of the commercial electric power, such as a big voltage variation and frequent electric power failure. Therefore, the running time of the electric generator is a phenomenal rate, and it causes the big loading to the generators and peripheral facilities. At the same time the frequent switching from commercial power to generator/from generator to commercial power brings a hard stress to the UPSs.
In connection with this subject, it is essential to maintain appropriately not only the radar equipment but also facilities and peripheral equipment.

Contents of Radar Maintenance Manual

1. Maintenance of facilities
    (1) Necessity of maintenance
    (2) Configuration of Radar observation facilities
    (3) Contents of maintenance
2. Maintenance data management and report
    (1) Data storage at site
    (2) Report system
    (3) Data storage at PRSD and PAGASA Central Office
3. Others
    (1) Spare Parts (Radar System)

[Other outcomes]

- System Engineer Training Document for Weather Radar Maintenance and Operation (107 pages)
- Weather Radar System – Weather Radar Maintenance and Operation – (41 pages)
- Glossary – Weather Radar System – (39 pages)

(4) Collected materials

The manuals and documents were collected in the baseline survey. They were delivered at CO and each radar site, but there was no spare set and a digital material.

Table 3-1-6 List of Collected materials

Title	Contents	Provider
Facility		Shimizu construction Co. Ltd.
Meteorological Radar station in the Philippines	Book1: Building, Power Supply	
	Book2: Incidental Facilities	
	Book3: Maintenance Guide	
	Book4: Instruction Manual	
	Book5: Drawings Collection	

Radar equipment		JRC
METEOROLOGICAL RADAR SYSTEM (Hardware: 7 volumes)	Book1 : Operating Guide	
	Book2 part1, 2 : Instruction Manual	
	Book3 part1, 2 : Maintenance Guide	
	Book4 part1, 2 : Test Instrument Manual	
METEOROLOGICAL RADAR DATA DISPLAY SYSTEM (Software: 2 volumes)	Book1 : Operating Guide	
	Book2 : Command Collection	
VSAT communication	V-SAT	Hakusan Electronics
Hand Over documents	OJT	Marubeni
HANDING OVER DOCUMENT	Book1 Signature, etc.	
	Book2 Instruction Manual	Shimizu
	Book3 OJT Documents	

3. 1. 4 Issues to overcome and the points devised in the activities

(1) Setting objectives

The activity of this output will be implemented as follows.

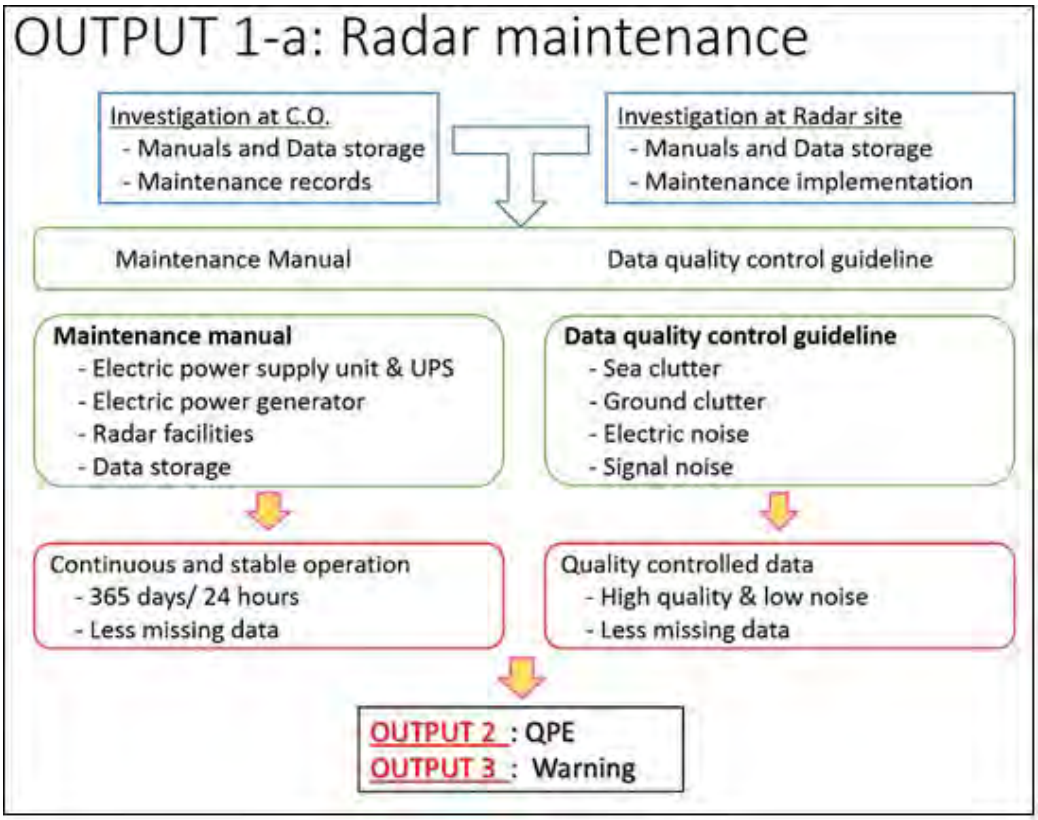


Figure 3-1-1 Activity image of the output

(2) Technical Working Group

The Technical Working Group (TWG) members were assigned by PAGASA. The activities in this output will be implemented by discussing with TWG members. The achievement of the activity will be reported to the officers as needed.

Table 3-1-7 TWG member (Radar Maintenance Group)

Name	Position
Mr. Edwin Manresa	OIC, ETSD
Mr. Fulgencio A. Austria	ETSD
Mr. Johny C. Zabala	OIC, Aparri Radar site, SLPRSD
Mr. Marianito Macasa	OIC, Guiuan Radar site, SLPRSD
Mr. Eufronio H. Garcia	CMO, Virac Radar site, SLPRSD

(3) Expected results

The outcome below is expected through the activities, such as development of Manual and Guideline, training on the maintenance of instruments and capacity building, of this output.

- The radar observation, in which missing data gets less, will be implemented continuously and stably.
- The high quality data, less noise and failure, will be obtained.
- The high quality data will contribute to the radar data correction, which is the outcome of the Output-2.

3. 1. 5 Achievement situation of the result

(1) Indicator 1-2 More than 80% of staff engaged in the maintenance of three radars, SYNOP stations and AWS pass the examination on maintenance methods of respective equipment.

Through the radar basic maintenance training, consultants confirmed that PAGASA implemented regular maintenance and recorded their results regularly. But trouble shooting reports were not reported and performance test was not implemented at Virac. In order to improve the situation and enhance senior radar maintenance activities, ‘radar senior engineer training’ at Virac targets radar core engineers is scheduled in February 2016.

The target goal of output 1 will be accomplished through the training with radar maintenance manual’.

(2) Indicator 1-3 Maintenance reports on respective equipment (i.e. radars, synop stations and AWS) are regularly produced and reported to the PAGASA Central Office.

Through the training, maintenance skills in senior level will be transferred to each radar site, and as a result, performance check is expected to start in Virac and Guiuan and regular maintenance, performance check and trouble shooting reports will be stored. Through such reporting, knowledge for radar maintenance will be enhanced and stored in PAGASA, and it brings enhancement of radar maintenance skills.

3. 1. 6 Recommendations for achieving the overall goal

In order for the Overall Goal "Capacity of all PRSDs is enhanced in terms of weather observation, forecasting and warning" to be achieved at higher level, it is important to improve the weather radar capacity continuously with the following points in mind.

(1) Measures taken at PAGASA HQ

1-1 In order to maintain and manage radar system, it is necessary to develop a system that is self-sustaining at sites including failure countermeasures. For that purpose;

1) Place an appropriate technical staff on the site.
2) In the absence of human resources, it is necessary to develop human resource training measures such as JICA support to train site radar technical staff. If it is difficult, outsourcing to entrust to maintenance and management, for example, consultants (available for part time work) appointment, annual maintenance contract with production maker, etc. are also effective.
3) Horizontal development of countermeasures, creation and distribution of report templates common to each site, against technical troubles and defects is important

1-2 In addition, as an urgent task common to each site, it can be considered that the stable supply of commercial power supply (the head office needs to negotiate with electric power company) is extremely important. For this purpose;

1) It is desirable to reduce frequent occurrence of sudden shutdown (power outage) of commercial power supply.
2) Since the fluctuation countermeasure due to the season and the time zone of the voltage value, that is, fluctuation of the electricity demand amount causes difficulty in stable operation, reexamination and change (if possible) of the power transmission route to the site is necessary. Furthermore, it is effective to install a sub station near the site.
3) A quick grasp of the cause of failure by use of the measuring instrument "power monitor" settled at the Radar site, which was used during the training period of JICA must be made.
4) Furthermore, it is recommended that periodic rust prevention painting (about every 3 years or so) of the site is necessary.

1-3 The operational mode setting of the radar should also be reviewed, especially the set value of the antenna elevation angle.

(Note: Although the S band radar which is superior to long range observation is used for the early detection of the typhoon, there is little merit of lowering the minimum elevation angle for long distance observation. However, present setting of the antenna angle is low, the advantage of the S band can not be utilized. We should consider reducing the noise on the radar screen (sea clutter) by reviewing the elevation setting for use as a quantitative observation radar.)

(2) Measures at each site

For each site of the radar, it should be ensured that regular maintenance work is carried out and reporting to the head office is always done.

Also, the following should be done regularly: (1) reliable periodic cleaning in the site premises, facilities, inside and outside the equipment (every 6 months), (2) torque checking and increasing tightening of the fixing screw between the panels of the Radome should be properly implemented and, (3) periodic replacement of compact UPS for radar monitoring and control terminals, or possession of spare (possession of radar system will be stopped if loss of compact UPS function is lost) etc. must be steadily implemented. Furthermore, when replacing a broken unit or board with a spare item, it is desirable to return it to the manufacturer promptly and repair it or replace it with a new spare item.

3. 2 Output1-b (Capacity on weather observation is improved)

3. 2. 1 Project Purpose

(1) Outputs and Objectively Verifiable Indicators

[Output] 1 Capacity on weather observation is improved.

[Indicator] 1-1 Traceability of Instrument is improved through development of reference guides regarding maintenance and calibration.

1-2 Capability of more than 80% of staff engaged in the maintenance and calibration of SYNOP/ AWS stations and RADAR stations is enhanced.

1-3 Maintenance reports on respective equipment (i.e. radars, synop stations and AWS) are regularly prepared and reported to the PAGASA Central Office.

(2) Activities

1-1 Identify current status and issues on maintenance of AWS and SYNOP observatory at Southern Luzon PRSD.

1-2 Develop manuals and plans for calibration and maintenance, and inspection guideline of AWS and SYNOP observatory at Southern Luzon PRSD.

1-3 Provide training on calibration and maintenance based on the above plans at Central Office and Southern Luzon PRSD.

3. 2. 2 Issues identified in the baseline survey

The baseline survey was implemented at weather observation stations in PAGASA CO, NCRPRSD and SLPRSD. Following issues were identified in the baseline survey.

(1) PAGASA meteorological standard instruments

Positive indications	PAGASA installed some national meteorological standards instruments and travelling standards instruments, such as a barometer, a thermometer, a rain gauge, etc. It also organized some calibration facilities at IRDU in CO. The digital instruments were prepared for sub-national standard and for a routine maintenance trip. The national meteorological standards instruments were calibrated against the national standard instruments and standard instruments of the international meteorological institutes. The traceability of the national meteorological instruments has been already established.
Challenges	PAGASA uses a pressure test chamber as the calibration equipment for a barometer. Since it is a calibration equipment for a mercury type barometer, it does not provide high enough resolution.

Cause and analysis	Above-mentioned issue stems from the fact that the PAGASA standard barometer and operational barometers at stations are mercury type. There is an expectation that the introduction of mercury-free barometer will be accelerated in light of approaching the ratification of the Minamata Treaty scheduled in 2020. In addition, since a digital type barometer has already prevailed in the world and will be prevailed in the Philippines, a calibration equipment for this type of barometer is required.
Counter-measure	[Organizational aspects] A solution is to introduce a calibration equipment similar to the one installed in RIC-Tsukuba, JMA. [Human resources aspects] It is required that the inspectors master the standard technique on the meteorological instrument calibration by using SOP, such as 'Calibration and maintenance manual' (hereinafter referred to as "Manual") 'Inspection guideline' (hereinafter referred to as "Guideline").

(2) Calibration and maintenance activity at station level

Positive indications	PAGASA dispatches engineers to the station once a year and implements regular inspections of meteorological instruments. The engineers conduct a comparative observation of station instruments with standard instruments carried from CO and secure the accuracy of instruments.
Challenges	The traceability of meteorological instruments except mercury barometer at a station is not secured enough. As for a barometer the comparative observation was conducted only at the indication value but not within the whole measuring range.
Cause and analysis	The target of the comparative observation is only a mercury barometer. As for other instruments the comparative observation was not conducted regularly. In order to secure the accuracy of observation value, a periodical (every several years) calibration for all instruments at IRDU in CO is required.
Counter-measure	[Organizational aspects] The maintenance and calibration system, in which all instruments are calibrated at IRDU in CO, is required. → Development of 'Calibration and maintenance manual' [Human resources aspects] It is required that the inspectors master the standard technique on the meteorological instrument calibration by using SOP, such as 'Calibration and maintenance manual'.

(3) Observation skill at station level

Positive indications	PAGASA developed MASSO (Manual of Surface Synoptic Observation) and delivered it to all stations. The synoptic observation is implemented based on MASSO at all stations.
Challenges	The synoptic observation is not performed at the time scheduled by WMO. Observation values are not consistent due to human error. The instrument error (index error) is not considered in the observation value.
Cause and analysis	MASSO includes instructions on how to handle the issues mentioned above, but, these instructions are often not followed at the station level.
Counter-measure	[Organizational aspects] Training on the synoptic observation for the station observers should be conducted regularly based on WMO guideline and MASSO. [Human resources aspects] The upskilling of the station observers is needed though the above-mentioned regular training.

3. 2. 3 Outline and outcomes of activities

(1) Outline of activities

In 2014, survey on the current status and operation of the PAGASA standard instruments and calibration equipment were implemented through interviews with personnel at IRDU in CO. In addition, a survey on the circumstance of the station, the current status of station instruments including AWSs, the maintenance system of equipment, and the management system of observation equipment was also implemented through interviews with personnel at stations in NCRPRSD and SLPRSD. In order to deepen the understanding on the traceability and the importance of maintenance and calibration system, lectures and training were conducted for personnel at IRDU.

In 2015, based on the results of the baseline inspection, field investigation and interviews with personnel at targeted area were done and an accurate barometer and its calibration system, which will be a base of precise atmospheric pressure measurement, were handed over and operation training was carried out for PAGASA staff.

In 2016, in order to refer the knowledge and experience into the calibration guidance and counsels to PAGASA staff, witness to the calibration work of meteorological instrumentation by the staff of the Regional Instrument Center (RIC-Tsukuba) of the Japan Meteorological Agency has been done and, also, the discussion and advice on the calibration technique and recommendation by the WMO Regional Instrument Center (RIC) were implemented and shared among the PAGASA staff.

In addition, to enhance a better traceability at broader region of the meteorological observatory in the Northern Luzon PRSD and the metropolitan area, meteorological site survey was enlarged to the major observatories in this target region.

Also, for the purpose of correcting the radar data, eight Automatic Rain Gauge stations (ARG) were installed in southern Luzon, PRSD and norther Samar, VPRSD on July 2016. In addition to attending this pre-installation inspection, we compared the present condition of rain gauge calibration of both countries were compared.

(2) Outcomes of activities

In 2014, investigation of current conditions of the meteorological observation, instruments calibration structure, and the atmospheric pressure observation and their issues in PAGASA were achieved through the field work. Information exchange about meteorological observation techniques was carried out through lectures and discussions at sites in the target region.

In 2015, based on the results of baseline inspection, inspections and measurements have been carried out for specific issues identified in the baseline inspection such as:

- Examination of performance and specifications of mercury barometer, which is used operationally at each station, and barograph, which is compared with mercury barometer.
- Based on the inspection of barograph in February to March 2015 at these stations, verification of the indicated values of operational barometers used at several stations in the Southern Luzon PRSD has been carried out.
- Barometers and the calibration instrument for barometer were handed out. The calibration data were set to be automatically downloaded to PC. This task was cooperated with persons in charge of calibration of meteorological instruments at PAGASA.
- Observation procedures and accuracy of the weather report were secured by the training, practice, and lectures by J-POW project.

In 2016, in order to refer the knowledge and experience into the calibration guidance and counsels to PAGASA staff, the staff of the Regional Instrument Center (RIC-Tsukuba), Japan Meteorological Agency joined the consultant member in the calibration work of meteorological instrumentation.

- Site survey was implemented in the Northern Luzon PRSD in addition to the Southern Luzon PRSD and National Capital Region PRSD, for insuring the high traceability of the surface observation, the survey and intercomparison of barometer.
- For insuring the accuracy and the traceability of the surface observation, field note for surface meteorological observation was designed and distributed to each site. It is now used for operational routine meteorological observation at each site.
- For a better calibration work for new barometers, which is newly purchased by PAGASA, a new jig

was designed and offered to PAGASA.

- The new observation and maintenance manual and the calibration guideline are now under editing with the person in charge in PAGASA. It is designed to update and adapted to the current situation of PAGASA's surface observation work flow.
- The confirmation of the calibration precision of the rain gauge for the ARG network, which cooperated with the PAGASA calibration section, has been implemented.

Table 3-2-1 List of Meetings and Interviews

Date	Attendee	Contents
18, 22 Aug. 2014 11, 13 Sep. 2014 24, 27, 29 Oct. 2014 4, 7, 12, 25, 27 Nov. 2014	Mr. Ferdinand Barcenas IRDU, ETSD	- Survey and hearing on the current situation in calibration and maintenance of meteorological instruments - Intercomparison of barometers at IRDU - Hearing on the current condition of meteorological instruments calibration system
27 to 29 Aug. 2014	CMO, CIO and duty observers, Catarman station, Sorsogon station, Legazpi station, Bucaf Agromet. station, Flood forecast center, Tabaco AWS	- Intercomparison of barometers at a station - Survey and hearing on the current situation in calibration and maintenance of meteorological instruments
4 Sept. 2014	CMO and duty observer, Science Garden, NCRPRSD	- Survey and hearing on the current situation in SYNOP observation
29 Oct. 2014	CMO and duty observer, NAIA station Professor, Manila observatory	- Intercomparison of barometers at a station - Survey and hearing on the current situation in calibration and maintenance of meteorological instruments
8 Nov. 2014	CMO and duty observer, Ambulong station, Tayabas station	- Intercomparison of barometers at a station - Survey and hearing on the current situation in calibration and maintenance of meteorological instruments
17 to 21 Nov. 2014	CMO and duty observer, Daet station, Pili Agromet. station,	- Intercomparison of barometers at a station - Survey and hearing on the current situation in calibration and maintenance of

	Legazpi station, Sorsogon station, Catarman station	meteorological instruments
13 Feb. 2015	Basic Met. Instrument Unit (BMIU)、Science Garden Station	- Survey on the current situation of maintenance of meteorological instruments - Collection of rainfall data
17 Feb. 2015	IRDU	- Confirmation of the list of the equipment provided - Hearing of the present situation of calibration and maintenance system of meteorological instruments
18 Feb. 2015	Office of the director of weather forecast division	- Handover of the confirmation with signature by Dr. Cayanan on the list of the equipment provided
18 Feb. 2015	IRDU	- Survey on the present situation of standard instruments for calibration of meteorological instruments
24 Feb. 2015	Science Garden St.	- Collection of rainfall data
25 Feb. 2015	Weather Division	- Hearing on the present situation of error check system of meteorological observation
2 Mar. 2015	IRDU	- Intercomparison of Barometer
3 Mar. 2015	Science Garden St.	- Inspection of Barograph
11 Mar. 2015	IRDU	- Discussion with Mr. Barcenas on the use of certificate stamp to specify the calibration result - It is decided that (1) stamp seat is designed by PAGASA and (2) this is printed and brought from Japan.
12 Mar. 2015	Climate Section	- Collection of data of mercury barometer and barograph at meteorological stations when typhoon approached.
30 July 2015	Science Garden St.	- Collection of rainfall data
3 Aug. 2015	IRDU	- Handover of certificate stamp seat of calibration and its ink made in Japan. - Inspection of barograph at Science Garden station compared with PAGASA sub-standard instrument
4, 6 Aug. 2015	IRDU	- Installation and training on the usage of

		barometer calibration system
12 Aug. 2015	Daet Station	- Inspection on the situation of the replacement of meteorological instruments - Inspection on the operational situation of mercury barometer and barograph - Intercomparison of mercury barometer and barograph
13 Aug. 2015	Pili Station Legaspi Station	- Inspection on the situation of the replacement of meteorological instruments - Inspection on the operational situation of mercury barometer and barograph - Intercomparison of mercury barometer and barograph
24 Nov. 2015	IRDU	- Handover of barometer provided
10-13 Mar. 2016	Daet Station, Pili Station, Legaspi Station, Ninoy Aquino International Airport station	It accompanied a field survey and technical guidance at each observatory of Daet, Pili, Legaspi in the Southern Luzon PRSD which the Japan Meteorological Agency staff went to and the Ninoy Aquino International Airport station with Mr. Barcenas of PAGASA.
14 Mar. 2016	Climate Division	To get the report data when the typhoon approaches
28 Jun. 2016	IT Section	The number confirmation by nine pieces of material for the ARG network
5 Jul. 2016	Tayabas Station	・ The update situation study of the meteorological instrumentation ・ The weather monitoring situation study (Mercury barometer could not be observed in the comparison because it is broken).
6 Jul. 2016	Casiguran Station	・ The update situation study of the meteorological instrumentation ・ The weather monitoring situation study, Intercomparison between digital barometer and mercury barometer, the observation technical guidance ・ It implemented with Mr. Barcenas of PAGASA.

8 Jul. 2016	Baguio Station	・ The update situation study of the meteorological instrumentation ・ The weather monitoring situation study, Intercomparison between digital barometer and mercury barometer, the observation technical guidance。 Based on inter-comparison of barometers, a new correction table was created. ・ It implemented with Mr. Barcenas of PAGASA.
11 Jul. 2016	Calibration Section, IRDU	・ The confirmation of the raingauge calibration status for the ARG network
12-13 Jul. 2016	Legaspi Station	・ The update situation study of the meteorological instrumentation ・ The weather monitoring situation study, Intercomparison between digital barometer and mercury barometer, the observation technical guidance which contains a lecture ・ The hearing of the observation field note trying-out result which was requested in August, 2015 and the collection of the field note
14 Jul. 2016	IT Section	・ The final indorsement work attendance of the ARG network equipment
15 Jul. 2016	The Swagelok Inc. agency	・ The procurement of the jig for the PAGASA purchase digital barometer calibration
19 Jul. 2016	Science Garden Station	・ Intercomparison between the Assmann psychrometer and the sling type psychrometer ・ It was implemented with Mr. Barcenas.
22 Jul. 2016	Science Garden Station	・ The raingauge data collection
5 to 6 Oct. 2016	Virac radar site, Virac station NAIA	· Accompanying Terminal Evaluation team (TE) · Survey of SYNOP observation facilities at Virac observation station, observation technology guidance, barometer comparison observation, radar observation

		facility survey at Virac radar site · Observation facility at NAIA observatory
11 Oct. 2016	Calibration Section, IRDU	· Measurement of gravitational acceleration
11 to 12 Oct. 2016	Calibration Section, IRDU	· Understanding the performance of PAGASA rain gauge calibration equipment

Table 3-2-2 Record of training

Date	Lecture, Practice, Training	Specific activity
10 Sep. 2015	Lecture	Lecture for the personnel at IRDU on: - The outline of the traceability - The importance of the calibration of the meteorological instrument - Introduction of the maintenance and calibration system in JMA
9 Mar. 2015	Lecture	Lecture on SYNOP observation and maintenance of meteorological instruments (Step 1) - Target: Persons in charge of SYNOP observation and meteorological instruments in PAGASA - Contents: Lecture on the necessity and importance of keeping the standard by MASSO for the operation of meteorological observation
10 Aug. 2015	Training	Training on the installation, adjustment, and operation of the calibration instrument for barometer
10 Aug. 2015	Lecture	Lecture on SYNOP observation and maintenance of meteorological instruments (Step 2)
11 Aug. 2015	Lecture	Lecture on SYNOP observation and maintenance of meteorological instruments (Step 2-2)
14 Aug. 2015	Lecture	At southern Luzon PRSD (Legaspi station), for staff in this PRSD: - Introductory lecture on SYNOP observation and maintenance of meteorological instruments; and - Lecture on SYNOP observation and maintenance of meteorological instruments (Step 1)
17 Aug. 2015	Lecture	- Lecture on SYNOP observation and calibration of meteorological instruments (Step 1)

		- Lecture on the stage of the calibration of meteorological instruments and its future (lecturer: Mr. Barcenas and Mr. Matsubara)
5 Nov. 2015	Lecture	Lecture on SYNOP observation and maintenance of meteorological instruments (Step 3)
24 Nov. 2015	Training	- Training on the procedure of the output data using PC for the calibration of barometer
1 Apr. 2016	Lecture	Lecture on SYNOP observation and maintenance of meteorological instruments (Step ４)
12 Jul. 2016	Lecture	Lecture on SYNOP observation and maintenance of meteorological instruments (Step ４) at Southern Luzon PRSD

(3) Outcomes

3-1 Information on the traceability of the meteorological instruments in PAGASA

3-2 Information about the weather observation system, observation environment and the meteorological instruments used in the Southern Luzon SLPRSD

3-3 Suggestions on surface observation and calibration of PAGASA

3-4 Creation and distribution of the observation field note

3-5 Information on correction value for pressure observation, correction table

(4) Collected materials

Title	Contents	Provider
MASSO	The observation guidance for basic of observation duties of PAGASA （MASSO: **Ma**nual of **S**urface **S**ynoptic **O**bservation）	Library of PAGASA

3. 2. 4 Issues to overcome and the points devised in the activities

(1) Setting objectives

The activity of this output will be implemented as follows.

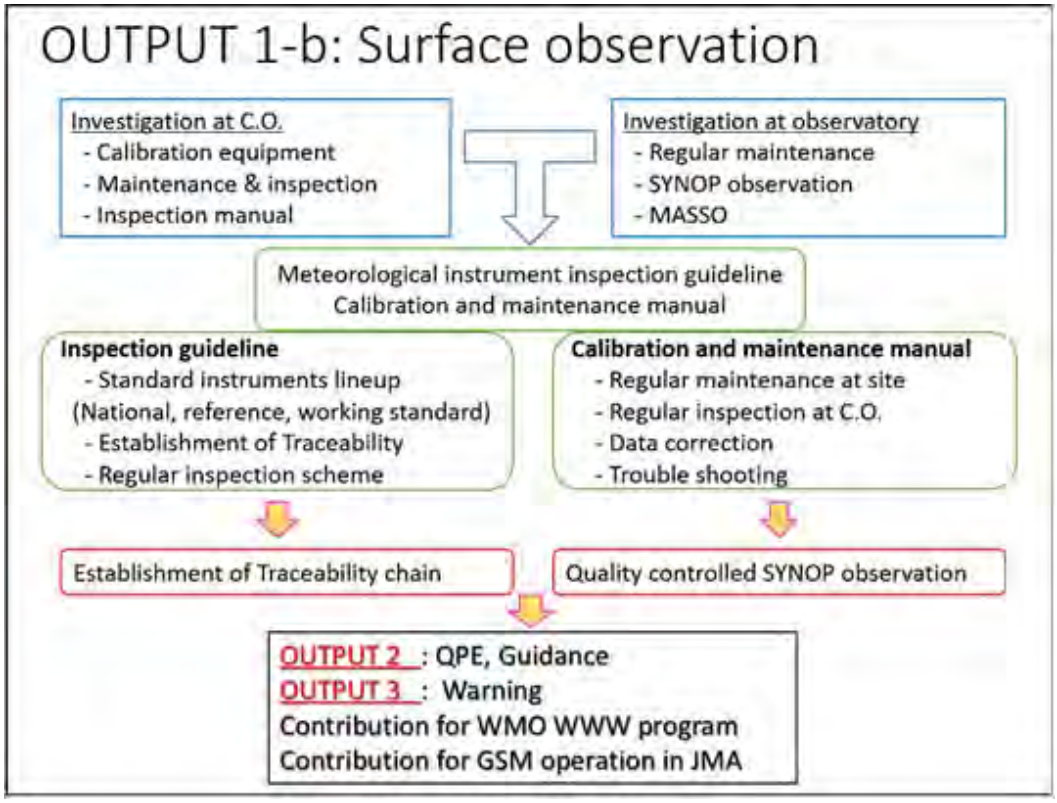


Figure 3-2-1 Activity image of the output

(2) Technical Working Group

The technical working group (WG) members were assigned by PAGASA. The activities in this output will be implemented by discussing with WG members. The achievement of the activities will be reported to the officers when needed.

Table 3-2-3 WG membership (Meteorological Instruments Group)

Name	Position
Mr. Ferdinand Y. Barcenas	IRDU, RDTD
Mr. Wilfred H Tuazon	IRDU, RSTD
Mr. Roberto M Celebre	BMIU, ETSD
Ms. Marilyn V. Medina	CMO, Science Garden Obs.,NCR PRSD
Mr. Arman R. Griante	NCR PRSD

(3) Expected results

The outcomes below are expected to be achieved through such activities as development of Manual and Guideline, training on the maintenance of instruments and capacity building.

- The traceability of PAGASA standard instruments and operational instruments will be improved.

- The precision of the observation will be raised and it will contribute to implementation of QPE, which are the outcomes of the Output-2.
- The contribution to the severe-tropical-storm forecast in the Philippines and Asia by improving the accuracy of surface pressure measurement
- The precise observation will contribute to the WWW program promoted by WMO.
- The precise observation will contribute to the improvement of Global NWP model prediction, which is operated by JMA and other countries.

3. 2. 5 Achievement situation of the result

(1) Indicator 1-1 Traceability of Instrument is improved through development of reference guides regarding maintenance and calibration.

To achieve the goal in the Indicator 1-1, "Manual on instrument calibration and maintenance" and "Implementation plan" will be issued. Technical instruction of maintenance of meteorological instruments using "Calibration guideline of Meteorological Instruments" was implemented at 6 observatories in Metro Manila region, 2 observatories in Northern Luzon PRSD, and Legazpi observatory in Southern Luzon PRSD. According to the field survey, the accuracy of atmospheric pressure observation based on the correction table at each observatory is not sufficient. Based on this situation, instruments for pressure calibration such as pressure regulator and pressure standard instruments were donated and, for establishing a scheme of calibration and maintenance, training and lecture on the barometer calibration using these instruments were implemented by the experts from JMA. Then, inspection at PAGASA Central Office and Legazpi observatory was completed and was confirmed that the traceability of the observation is secured at each observatory.

For these reasons, it is confirmed that the Indicator 1-1 was achieved satisfactory. Quantitative evaluation of the achievement of the Indicator will be carried out in the final year.

(2) Indicator 1-2 Capability of more than 80% of staff engaged in the maintenance and calibration of SYNOP/ AWS stations and RADAR stations is enhanced.

In order to ensure the traceability of pressure measurement, which is one of the important items of surface observation, capacity of the observation staff should be enhanced on the basic knowledge of calibration technology and method. So far, guidance and commentary on the traceability technology at each meteorological station by the team member has been done and a training by short term experts from JMA has been implemented to date. In addition, hands-on training and lectures were carried out at PAGASA Central Office and Legazpi Observatory twice and guidance for the accuracy of day-to-day maintenance and the observation time was carried out. As for the AWS, which monitors the same meteorological elements as surface observation, it was confirmed that the

calibration has been performed properly in the technical division of PAGASA before and/or after the maintenance of the AWS system.

Based on the revision of "Manual on instrument calibration and maintenance", further training and on site instruction will be implemented for achieve the Indicator 1-2 in the final fiscal year.

(3) Indicator 1-3 Maintenance reports on respective equipment (i.e. Radars, SYNOP stations and AWS)

For the achievement of the Indicator 1-3, training by "Manual on instrument calibration and maintenance" and "Implementation plan" will be implemented and periodic inspection book and report on the inspection will be drawn. For the periodic publication of the maintenance report of each instrument, periodic practice of inspection and its report are specified in the Manual and the Guideline. Also, instruction for ensuring the periodic report to PAGASA Central Office will be made by "Implementation Plan". To ensure these works, observation field note was also designed and circulated to meteorological stations for use in everyday observation record.

As for AWS, it is difficult to repair the instrument at the observation site due to the following reasons: 1) the maintenance of instruments is assigned to ETSD at the PAGASA Central Office and 2) type and specifications of the observation instruments are diverse depends on the installation years and supplier. For this reason, the goal of the training was focused on the level up of the observation staff so as to understand the principle of each instrument and to be able to send a report the trouble situation to PAGASA Central Office when instruments are in trouble.

From the above, it is concluded that this indicator 1-3 will be achieved successfully. It is noted that, whether regular maintenance report has been made or not, the evaluation is carried out in the latter half of the last fiscal year.

3. 2. 6 Recommendations for achieving the overall goal

In order to achieve the overall goal, it is required to pay attention to the modernization of the observations advanced by PAGASA and to the following points in advancing the plan.

(1) To establish a maintenance workflow regularly and to continue it.

(2) The observer should record data records such as observation conditions, data calibration and correction procedures in detail in the observation field book so that the inspector can reliably perform data checks later on.

(3) Regarding AWS operation, it is needed to pay special attention to the following matters;

· Maintenance personnel should be familiar with AWS manual

· Prevent the influence of insects and dust as much as possible

· Doing installation to avoid high temperature and excessive humidity
· Prevent long-term power failure
· Stable power supply
· Understanding the characteristics of AWS through comparative observation of AWS and conventional measuring instruments

(4) Management of metadata and correction tables

The following points are important and these meta information of the sites should be noted and shared among each observatory and PAGASA HQ.

4-1 Change relocation of observation point (Lat., Long., and ASL), renovation of building, change of installation state of instruments, and replace of the instrument.

4-2 Environment change around the observation place

4-3 Change of instruments (model, change of coefficients etc.) is an important element, observatory and main office Share common information with.

Raw data from meteorological instruments always contain error. Share the the correction table and manage it correctly. The correction table used for data correction should share among staff in the observatory.

(5) Introduction of new observation system

· Before introducing a new observation system and equipment, it is strongly recommended for staff of the observatory to understand the characteristics of the new equipment.
· In addition, make comparative observations of old and new instruments adequately and fully grasp the instrumental error between two instruments. Unless this procedure will not properly perform, the climatological data at the site will give incorrect information due to instrumental error.

3. 3 OUTOUT 2-a (SATAID and radar data analysis)

3. 3. 1 Project Purpose

(1) Outputs and Objectively Verifiable Indicators

[Output] Capacity on meteorological data analysis and forecasting is improved.

[Indicators] 2-1 Capability of 80% of the operational staff on the use of SATAID is improved.

2-2 Software for radar data calibration with rain gage data is developed.

(2) Activities

2-1 Provide training on the operation of SATAID.

2-2 Provide training on methods to correct radar data by using surface observation data.

3. 3. 2 Issues identified in the baseline survey

The baseline survey was implemented in weather division etc. of PAGASA in November 2014.

Following issues were identified during the baseline survey.

(1) Usage of SATAID

Positive Indications	SATAID is operationally used as a monitor of satellite data at PAGASA weather forecast section and many staff members are using it as an analysis tool at their desks.
Challenges	(i) SATAID is less frequently used for weather situation analysis at weather briefings, (ii) AWS and RADAR data is not composed on satellite data yet and (iii) PAGASA has to prepare for usage of new satellite data that is scheduled to be started in summer 2015.
Cause and analysis	(i) At the weather briefing, discussion for forecast of NWP (Numerical Weather Prediction) are mainly implemented, however, analysis for actual situation to correct Numerical Weather Prediction with observation data is not enough. (ii) AWS and RADAR data should be provided on operational monitors at the weather forecast section. (iii) The consultant has not checked the preparation status of PAGASA for the next generation satellite at the time of November 2014.
Counter-measure	(i) The training on Dvorak methods and lectures/exercises on the usage of next generation satellite data by JMA short-term experts are scheduled for February 2016. After these exercises, PAGASA/consultant will promote SATAID usage for actual situation analysis. (ii) In conjunction with PAGASA, consultants will try to build AWS and RADAR data usage system with SATAID.

(2) RADAR data calibration with rain gauge data

Positive Indications	Aparri and Virac RADAR data is transmitted to PAGASA weather forecast section and used for monitoring weather condition for weather forecast and warning.
Challenges	RADAR data is used only for qualitative analysis.
Cause and analysis	RADAR data is used mainly to monitor weather condition for weather forecast. In order to develop advanced RADAR data usage (RADAR data quantitative analysis and applying for run-off model or land slide index model), RADAR data calibration with rain gauge data is required.
Counter-measure	In JMA, Quantitative Precipitation Estimation (QPE) and Quantitative Precipitation Forecast (QPF) are carried out by using RADAR data and rain gauge data. In order to develop QPE system in PAGASA the following terms should be implemented: (i) RADAR data and AWS data storage for at least one year (ii) Quality control of RADAR data (iii) RADAR data calibration with rain gauge data In order to improve terms mentioned above, the working group collaborates to carry out the research. In relation to the term (i), ICT section began storing data from 2014. R&D, ICT section and consultants continuously cooperate to store RADAR/AWS data for the research.

(3) Usage of hourly precipitation data

Positive Indications	PAGASA operates more than 70 AWS stations.
Challenges	According to the baseline survey, the number of AWS stations which can provide hourly precipitation data in real time is only 30 to 40. At SYNOP stations, 6-hourly precipitation is manually observed and reported operationally, however, hourly precipitation data is not reported. In order to calibrate RADAR data with rain gauge data, the number of real-time rain gauge stations should be increased.
Cause and analysis	(i) At SYNOP stations, rain gauge data is not automatically recorded, and a data acquisition network for real-time rain gauge data is not in operation. (ii) A system to collect rain gauge data continuously is not stable.
Counter-measure	(i) Consultants experimentally set rain gauge data logger at PAGASA Science Garden and started hourly precipitation data recording from November 2014. Additionally PAGASA METIT section and consultants plan to construct an experimental rain gauge network in Southern Luzon PRSD to collect rain gauge data in real time. (ii) The working group continuously implements a research survey to collect rain gauge data and to compare RADAR rain intensity data with rain gauge data.

3. 3. 3 Outline and outcomes of activities

(1) Outline of activity

1-1 [SATAID, satellite images]

According to the base line survey, PAGASA staff members often use SATAID to monitor satellite data and satellite images are always displayed on the PAGASA weather forecaster room. However, SATAID is rarely used for actual weather situation analysis, and AWS or RADAR data is not composited on satellite images.

From July 2015, new satellite 'Himawari-8' was in operation. PAGASA downloads satellite data by (a) ftp from cloud server managed by JMA (Japan Meteorological Agency) and receive HimawariCast data through (c) the antenna set by PAGASA from December 2015. PAGASA already uses 10-minute intervals satellite data to monitor actual weather situation.

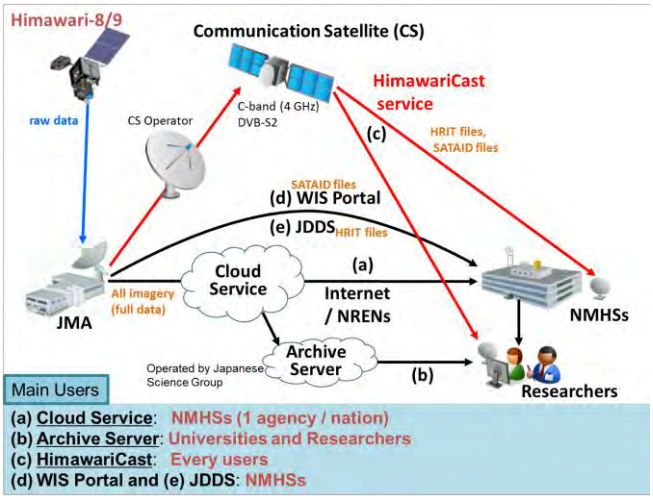


Fig. 3-3-1 How to get HIMAWARI8 data (JMA web site)

Consultants implemented a basic lecture for 'SATAID usage' and 'satellite data (IR1, WV and VIS) features' in November 2014. They showed samples to overlay AWS data on satellite images, however, daily composition of AWS data on satellite data is not in operation because real-time collection of AWS data is not stable and not in operational.

For the next phase, short-term expert training for enhancement of satellite data usage are scheduled in February 2016. The trainings include lectures/exercises for 'Himawari-8 data usage', 'SATAID usage for Himawari-8' and 'Dvorak methods' (Training on 'Dvorak methods' is added to meet the strong requirement by Mr. Leneto, because 'Dvorak methods' is one of the most important skill for PAGASA typhoon analysis).

In October 2016, working group developed a software to transform AWS and radar data to overlay on satellite images with SATAID. Additionally, scripts for operational use (download AWS and radar data, transform them for SATAID) were developed. Software and scripts for composing satellite, radar (for JRC radar) and AWS data were prepared.

1-2 [RADAR data calibration with rain gauge data]

PAGASA operates 3 JRC RADARs (Aparri, Virac and Guiuan), EEC RADARs and Vaisala RADARs and these RADARs cover the whole Philippines area. The RADAR data is stored in original format of each manufacturer and in NetCDF format. And PAGASA IT section stored such data under [radar] folder of PAGASA D/B (the data is moved to DAT after a certain period). These operation is implemented by PAGASA IT section and an approval from IT section is required to use radar data. In order to use RADAR and AWS data, the working group gets ID to access to the D/B server and set it on the project PC.

The number of ARGs (Automated Rain Gauge) is 76 and ARG data is collected in 10 or 15-minute intervals. The ARG data can be monitored on the following websites.

http://meteopilipinas.gov.ph/map.php

http://pis.meteopilipinas.gov.ph/climps/?page=arg.

In addition, the 15-minute interval AWS (Automated Weather Station) data is opened on the following Website.

http://www.dostpagasa.com/

These data are automatically updated at 10 or 15-minute intervals, however, update operation is not stable.

In February 2015, the JMA short-term expert implemented trainings on 'RADAR data usage and products' for 6 staff members of weather forecast division and R&D section, and training on 'RADAR data quality management' for 28 staff members of mainly weather forecast sections.

In June and December, the working group implemented a comparison of R1 data (1-hour rain intensity data calculated by JRC RADAR server automatically) and AWS/ARG data, however, comparison results could not show good relationship. Such poor relationship seemed to be brought by insufficiency of continuous and comparable data.

In order to improve such situation, the rain gauge observation network was planned in Southern Luzon PRSD to compare Virac RADAR data and rain gauge data observed by the network. The preliminary site survey was implemented in April 2016. The network consists of 9 ARGs was established in July 2016 after due preparation procedures such as system design and procurement of materials.

In June and October 2016, the working group developed software, to compose PPI (Plan Position Indicator) mode data of Virac and Aparri radar, to calculate rain intensity from composed PPI data, pickup radar data for comparison with AWS data. And the working group collected AWS and radar data during heavy rain events and implemented comparison AWS and radar data. Software and scripts for preliminary quantitative precipitation estimation were prepared.

(2) Details of activity

2-1 [November 2014]

The base line survey mainly focused on the following terms.

- Actual situation of SATAID and RADAR data usage at PAGASA weather forecast section;
- Availability of collecting real-time data and archiving historical data of RADAR, AWS and ARG.

Based on the result of the base line survey, consultants collected AWS data from PAGASA Website and PAGASA archive server (in conjunction with PAGASA ICT section), and experimentally tried to transform AWS data to SATAID format. The transformed AWS data was used for the lecture carried out on 13 November 2014, in which the consultant demonstrated how to display PAGASA AWS data with SATAID.

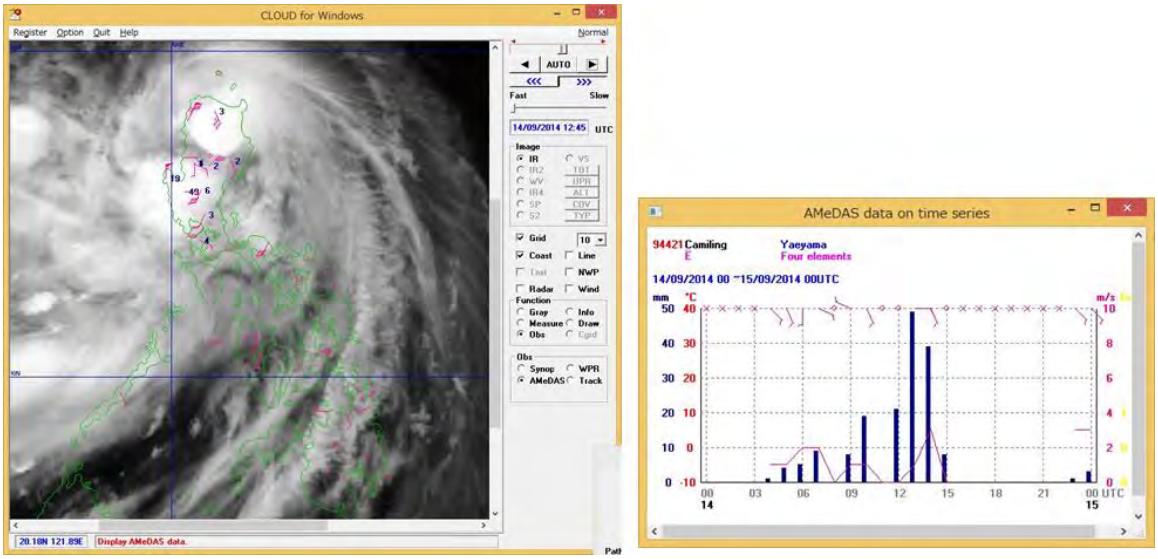


Fig. 3-3-2 An example of AWS composition on satellite image by SATAID (September 2014)

PAGASA uses emphasized satellite images based on ranks shown in Fig. 3-3-3. Based on the request of PAGASA, consultants developed software to convert BMP images produced by SATAID software into emphasize images (Fig. 3-3-4). The software was shared with PAGASA weather forecast division.

OUTPUT LEVEL	TEMP. (°C)	REASON FOR ENHANCEMENT	COLOR
0- 89	76 to 26.7	No Meteorological Interest	
90- 148	26 to -1.5	Low Cloud Enhancement	
149- 194	-2.1 to -30.9	Middle Cloud Enhancement	
195- 221		Convective Cloud Enhancement	
222 - 225	-56.6 to -60	Tropopause Temperature	
226- 238	-61 to -78.9	OVERSHOOTING TOPS	
239- 247	-80.8 to -99.39		
248- 254	-102.5 to -129.49		
255	-136		

Fig. 3-3-3
A table of satellite image emphasis.

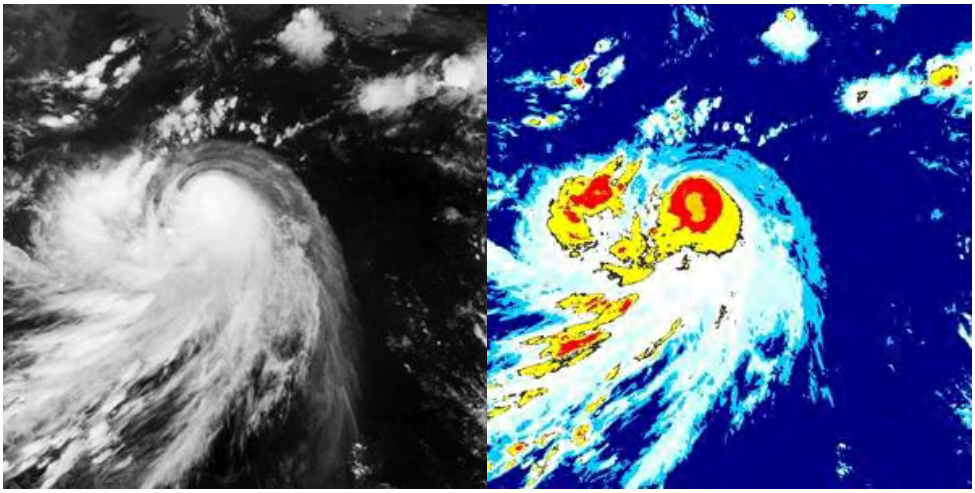


Fig. 3-3-4　Emphasized image (left: original, right: emphasized)

2-2 [February 2015]

Mr. Nagata, a short-term JMA expert, provided lectures/exercises shown in Table 3-3-1 for 'radar data usage and products' for 6 to 9 staff members of R&D section and weather forecast division. He also implemented training on 'RADAR data quality management' for 28 staff members (mainly weather forecasters).

The consultant connected a project PC to PAGASA network and developed/started scripts to download AWS data regularly in order to compare RADAR data with AWS data.

Table 3-3-1　Training on RADAR data usage (February, 2015)

	20/Feb.(Fri.)	23/Feb.(Mon.)	
AM	Radar maintenance (by Mr. Wakabayashi)	Discussion for development radar data calibration with AWS data	
PM	Principles of Weather radar Observation	Quantitative precipitation estimation	
	25/Feb.(Wed.)	26/Feb.(Thu.)	27/Feb.(Fri.)
AM	Quality control of radar data	Application of radar data	
PM	Exercise for QPE	Quantitative precipitation forecast	Quantitative precipitation forecast

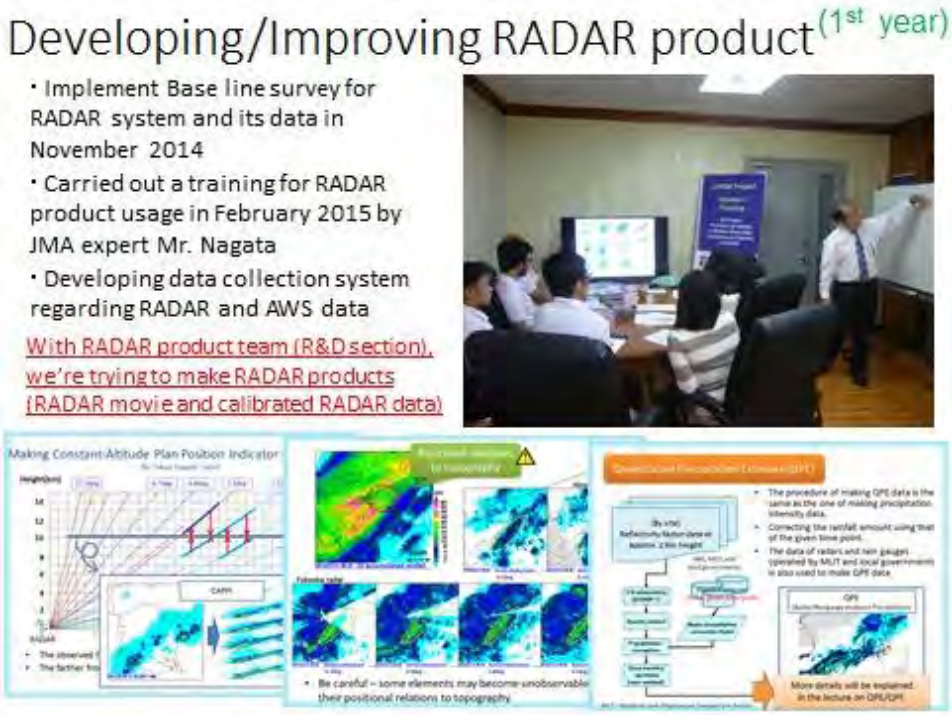


Fig. 3-3-5 Training on RADAR data usage (February, 2015)

2-3 [June 2015]

In order to compare RADAR and AWS data, the working group collected R1 data (1-hour rain intensity calculated by JRC RADAR server automatically) of Aparri and Virac and AWS data from 20 June to 15 July, and tried to compare R1 data with AWS data. R1 data is formatted as square grid data, so in order to pick up the nearest grid data at each station, sample software (coded by C) was developed and shared in the working group. The working group compared R1 data with AWS data during the training in October and in December.

The working group further improved scripts (windows bat files) to collect data and confirmed the scripts downloaded and stored data automatically. Additionally, the working group developed scripts (windows bat files) to download Tagaytai RADAR images and make a 2-hour radar movie automatically. The result was utilized in output 4 activities as PAGASA Website contents for mobile phones.

2-4 [November to December 2015]

The working group tried a comparison of R1 and AWS data, and the working group developed software (coded by C) to compose rain intensity data from 3 lower PPI data shown in Fig. 3-3-6. The result of comparison (shown in Fig. 3-3-7) could not show clear relationship between R1 and AWS data. The working group supposed that such poor result was mainly caused by missing data in both data set.

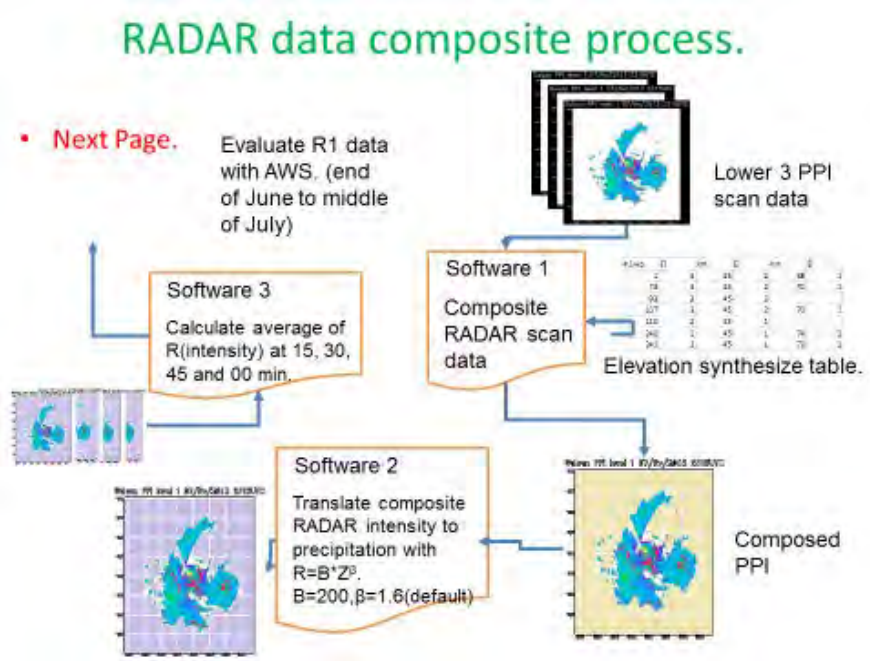


Fig. 3-3-6 Process of RADAR composition and rain intensity calculation.

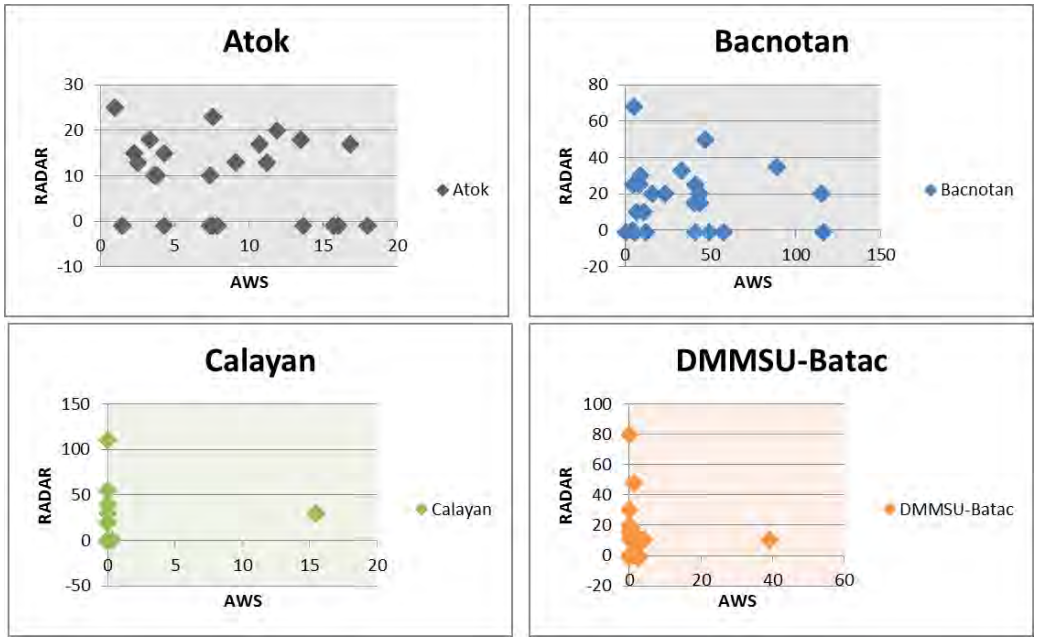


Fig. 3-3-7 A comparison of RADAR rain intensity with AWS (July 2014)

Based on these results, the working group planned to try the following activities in the next phase.

- As RADAR rain intensity, 2 km CAPPI data would be used (as JMA uses)
- In conjunction with PAGASA METIT team, a 10-rain gauge network will be constructed experimentally and real time rain gauge data will be collected in southern Luzon.
- The working group will continuously collect historical RADAR and AWS data.
- Scripts/network will be developed to collect RADAR and AWS data automatically.

2-5 [February 2016]

(Short-term expert training for enhancement of satellite data usage)

The technical training for enhancement of satellite data usage was conducted at PAGASA headquarters in a period from 15 to 19 February by three short-term experts from Japan Meteorological Agency, i.e. Mr. Hideyuki Kawada [SATAID], Ms. Naoko Komatsu [Dvorak methods] and Mr. Ryo Yoshida [HIMAWARI-8].

The contents of the training are shown in Table 3-3-2 included utilization of HIMAWARI-8 data and SATAID, basics of meteorological satellite analysis and Dvorak technique exercise. On the last day the certificate for the completion of the training was issued to 22 trainees by JICA expert, Mr. Nobuo Sato.

Table 3-3-2 Contents of the training for enhancement of satellite data usage

in 2016	09:00 – 12:00	13:00 – 15:00	15:00 – 17:00
15th Feb.	Country Report and Site visit	Overview of Himawari-8/9	Utilization of SATAID
16th Feb.	Basics of meteorological satellite and satellite analysis	Basics of meteorological satellite analysis	Analysis training
17th Feb.	Analysis exercise with 17th/Feb. satellite images	Dvorak technique	
18th Feb.	Dvorak technique exercise	Dvorak technique exercise	
19th Feb.	Utilization of newly equipped bands. RGB composite	Practical training on utilization of RGB composite	Discussion

At the end of the training, an achievement test on “meteorological satellite and features of HIMAWARI-8”, “utilization of SATAID” and “Dvorak methods” was conducted. In terms of “meteorological satellite and features of HIMAWARI-8”, a preliminary test before the training was also conducted and then improvement of understanding level could be verified. All trainees improved their understanding level and furthermore over three-quarters of them achieved more than 50% improvement. As the result high level effectiveness of the training could be confirmed as shown in Figures 3-3-8 and 3-3-9.

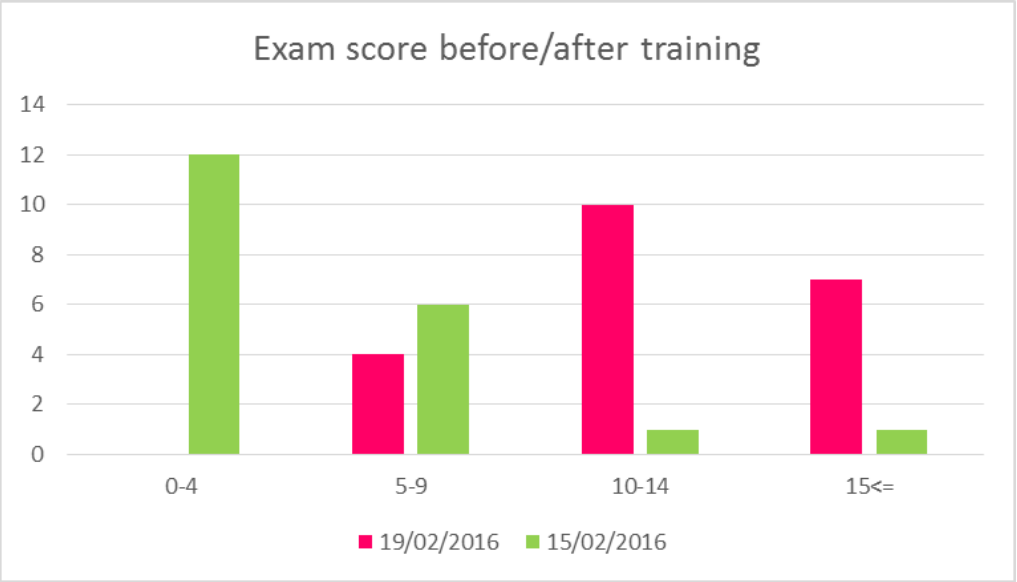


Fig. 3-3-8 Comparison in understanding level for "meteorological satellite and features of HIMAWARI-8" (Green: before the training, Red: after the training)

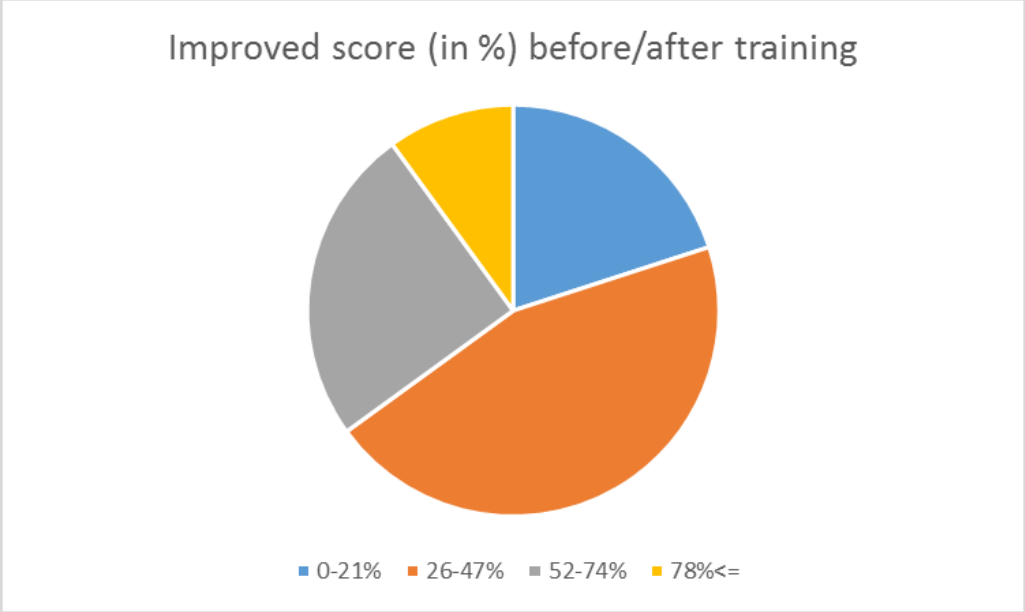


Fig. 3-3-9 Improving rate of understanding level for "meteorological satellite and features of HIMAWARI-8" (evaluated by (score after - score before) / score before)

Questionnaire survey on the training was conducted at the end of the training. The fact that many of evaluation scores were more than 4 showed high evaluation on the training by trainees. On the other hand, average scores on difficulty and time were 3.1 and 3.6, respectively. Therefore it is required as a point of improvement that training should be thorough and understandable on the condition of having spare time.

The following action items were confirmed in the discussion at the end of the training:

(1) Establish a team on satellite analysis within Weather Division in PAGASA, analyze

HIMAWARI-8 and endeavor to improve technical capacity in cooperation with Japan Meteorological Agency;

(2) Following-up trainings on satellite analysis would be expected in a year.

Table 3-3-3 Evaluation on the satellite training by questionnaire

				1	2	3	4	5	6	7	8	9	10
	Name	Section/ Division	Sex	Impression	difficult	understanding	useful	environment	time	presentation	explanation	Power Point	handout
1	Roberto S. Sawi	WFS / WD	M	5	4	4	5	4	4	5	4	5	4
2	Benison Jay N. Estareja	WFS / WD	M	4	4	4	5	4	4	4	3	5	5
3	Loriedin A. dela Cruz	WFS / WD	F	4	3	4	5	4	3	4	5	4	5
4	Christopher F. Perez	WFS / WD	M	5	3	4	5	5	3	5	5	5	5
5	Renito B. Paciente	MMSS/WD	M	4	1	4	4	4	3	4	4	4	4
6	Robert B. Badrina	MMSS / WD	M										
7	Shelly Jo I. Ignacio	MMSS / WD	F	5	4	4	5	4	4	4	4	5	4
8	Juanito S. Galang	MMSS / WD	M	4	3	4	5	4	4	4	4	4	4
9	Vicente C. Manalo III	TAMSS / WD	M	3	3	4	5	4	4	3	3	4	4
10	Anselmo A. Almazan II	TAMSS / WD	M	5	3	5	5	5	3	5	4	5	5
11	Charlie R. Rapadas	TAMSS / WD (MSF)	M	4	3	4	5	4	3	4	4	5	4
12	Teresa A. Millanes	TAMSS / WD (MSF)	F	5	4	5	5	4	4	5	5	5	4
13	Menandro A. Mendoza	TAMSS / WD (MSF)	M	4	3	4	5	4	4	4	4	4	4
14	Alexis Ruivivar	TAMSS / WD (MSF)	F	4	3	4	5	4	4	4	4	5	5
15	Michael C. Mangubat	AMSS / WD	M	4	4	3	4	4	4	4	4	4	4
16	Calil C. Hadjilatip	AMSS / WD	M	4	3	4	4	4	4	4	4	4	4
17	Efren B. Macatangay	AMSS / WD	M	5	3	4	5	4	3	5	5	5	5
18	Sonia P. Serrano	HMD	F	4	3	4	4	4	4	4	4	4	4
19	Eva L. De Paz	HMD	F	4	3	4	4	4	5	4	4	4	4
20	Analiza C. Tuddao	RDTD	F	5	3	4	4	4	3	4	4	5	5
21	Ma. Cristina Uson	RDTD	F	5	3	4	5	4	3	5	5	5	5
22	John Mark Dolendo	RDTD	M	5	3	4	5	5	3	5	5	5	5
				4.4	3.1	4.0	4.7	4.1	3.6	4.3	4.2	4.6	4.4

2-6 [April to August 2016]

(RADAR data calibration with rain gauge data)

The process of RADAR data calibration with rain gauge data is shown in Fig 3-3-6. RADAR data from each site are transmitted to PAGASA headquarters via satellite links and are monitored by a RADAR monitoring terminal in Weather Division. The data is transferred to PAGASA-D/B on the trigger by time-driven scripts, and then are archived into DAT after a certain period.

In order to find RADAR calibration factors it is necessary to store RADAR and rain gauge data for a long period. In this context, RDAR and rain gauge data have been downloaded from PAGASA-D/B

and stored periodically on an operational basis since June 2015.

For OUTPUT2-a, Activity2-2 “Software for RADAR data calibration with rain gage data”, the working group developed, evaluated and modified the following software (mainly Software 1 to 4 in Fig 3-3-10).

- Software 1 to compose a RADAR data from plural PPI data
- Software 2 to translate the composed RADAR data to rain intensity by using the RADA formula and calibrate it by table parameters
- Software 3 to calculate 1 hour precipitation data from intensity data at 15-minute intervals
- GrADS scripts to draw a rain intensity picture from 1 hour precipitation data
- Time-driven scripts to arise 4 processes above
- Software 4 to extract 1 hour rain intensity data at specified points from 1 hour precipitation data in order to compare with rain gauge data

A draft manual for the software and scripts was developed as “Memorandum of JRC radar analysis”. At this stage, there are not enough data to compare between RADAR and AWS because of lack of data collection. Calibration parameters are still non-functioned.

2-7 [February to April 2016]

(Preparation for ARG network in Southern Luzon)

Meteorological Radar information can be used for a key information to analyze the QPE (Quantitative Precipitation Estimation) when it is coupled with realtime rain gauge network within the radar coverage. This information is capable for applications such as warning information. For this reason, the working group has planned to construct a ARG (Automatic Rain Gauge) network in the Southern Luzon PRSD, which is located within the Virac radar coverage. For the development of an experimental rain gauge observation network in Southern Luzon PRSD to calibrate Virac RADAR data, the site survey based on the study of potential installation lots was conducted in April 2016. In addition to appropriateness in observation environment, radio-signal strength of mobile telecom networks, security, land owners and other practical items were investigated. As the result, nine sites were appointed to install ARGs.

2-8 [July 2016]

(Installation of ARG network in Southern Luzon)

In the system design, product types of data-logger, SMS modem and charge controller were selected and also suitable capacities for solar panel and battery were specified. According to the design, necessary equipment and materials were procured during from May to July. Rain gauges with measuring verification certificated in Japan were transported by air to Manila in order to keep accuracy and reliability necessary for QPE.

Two installation teams formed by C/Ps and consultants proceeded with on-site work in parallel to efficiently install ARG systems at the nine appointed sites in a short period from 17 to 22 July. On the

occasion of the installation the teams came up with various ideas to make operation and maintenance easier thanks to good collaboration between C/Ps and consultants. ARG data has been collected at 10-minute intervals since installation. The ARG data can be monitored on the following Websites.

http://v2.meteopilipinas.gov.ph/

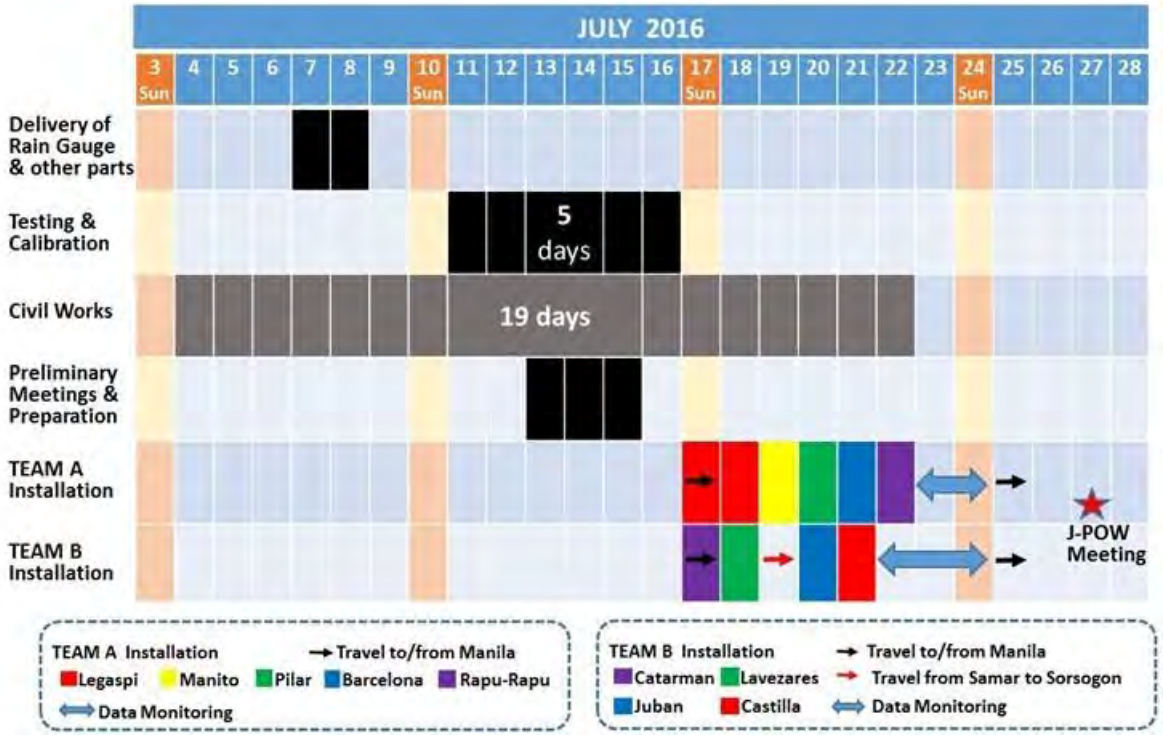


Fig. 3-3-10 Activity progress of installation of the ARG network in SL-PRSD

Fig. 3-3-11 Preliminary tests and preparation towards ARG installation

Fig. 3-3-12 Procedures of on-site work for ARG installation

Fig. 3-3-13 Outlined configuration of the rain gauge observation network in SL-PRSD

Fig. 3-3-14 Installation sites of the rain gauge observation network in SL-PRSD

2-9 [October 2016]

In June 2016, scripts for auto download and storage for AWS/ARG data and PPI data of Aparri/Virac/Guiuan were developed and automatic storage was started. And Southern Luzon rain gauge started its observation in July 2016. 3 months data (July to September) was stored but it was not enough for analysis, because there were few heavy rain events during the period. However, 2 typhoons hit Luzon islands in October 2016 (typhoon SARIKA landed on central Luzon from 15 to 16 of October and typhoon HAIMA landed on northern Luzon from 19 to 20 October) and the group obtained AWS and radar data during these events.

The group improved following software developed in June 2016,

- Software 1 to compose a RADAR data from plural PPI data
- Software 2 to translate the composed RADAR data to rain intensity by using the RADA formula and calibrate it by table parameters
- Software 3 to calculate 1 hour precipitation data from intensity data at 15-minute intervals
- GrADS scripts to draw a rain intensity picture from 1 hour precipitation data
- Time-driven scripts to arise 4 processes above

In this period, software 4 to extract 1 hour rain intensity data at specified points from 1 hour precipitation data was developed. And following software was developed additionally,

- Software to transform radar data for overlaying on satellite images using SATAID
- Software to transform AWS/ARG data for overlaying on satellite images using SATAID and make monthly reports

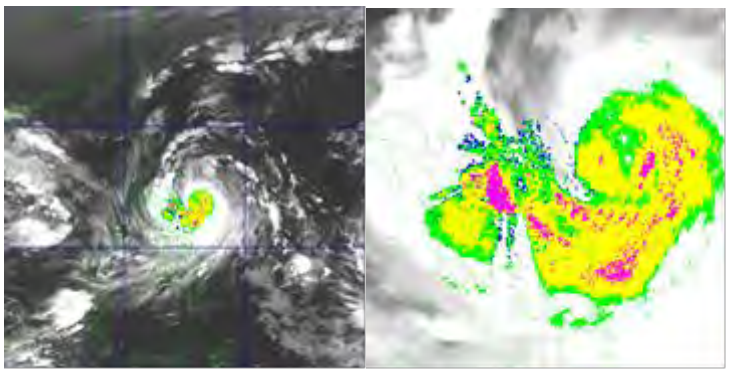


Fig. 3-3-15
Overlay radar and AWS/ARG on satellite image

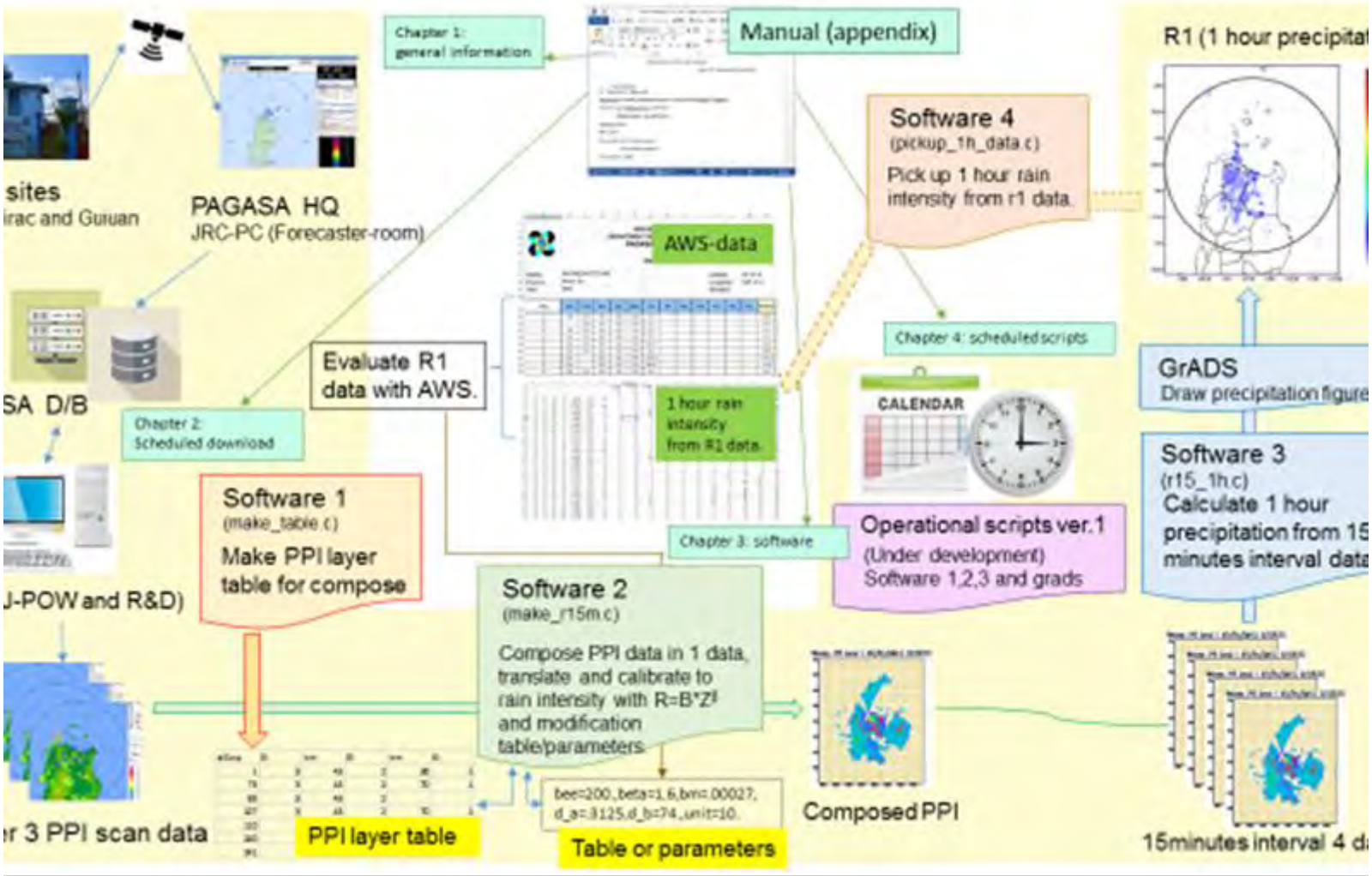


Fig. 3-3-16 Process flow of RADAR data calibration with rain gauge data

Table 3-3-4 Record of meetings

Date	C/P	Contents
4-7,11-12 November 2014	Mr. Harry Alcantara, Mr. Alvin Cleofas (ICT)	Survey on real-time and historical RADAR and AWS/ARG data and their usage at PAGASA weather forecast section Request for collecting archived RADAR and AWS data (11 Sep. 2014) for SATAID training
4, 8-10 November	Dr. Vincent Palcon, Mr. Raymond C. Ordinario (WFFC)	Survey on SATAID usage at PAGASA weather forecast section Experiment on converting PAGASA-AWS data to SATAID format and operation test of monitoring AWS data with SATAID
10 November	Ms. Fredolia D. Baldonado (PAGASA-PRSD)	Survey on rain gauge equipment and record of precipitation data at PAGASA science garden
14 November	Mr. Michael Bala (R&D)	Discussion on RADAR data usage and development of nowcast
23 February 2015	Mr. Michael Bala	RADAR product developing plan
14 July	Mr. Michael Bala Mr. Evan JK Carlos Mr. Ramjun Sajulga	Comparison of RADAR and AWS data. Survey on historical RADAR and AWS data
13 December	Mr. Michael Bala Mr. Ramjun Sajulga Ms. Maria Ana Glaiza Escullar	Comparison of RADAR R1 with AWS data. Process of RADAR PPI data composition and rain intensity calculation
30 May 2016	Mr. Erie Estrella	Confirmation of system design for the rain gauge observation network, and procurement coordination
13-17 June	Mr. Michael Bala Mr. Ramjun Sajulga	Development and improvement for radar data calibration with AWS
11-16 July	Mr. Erie Estrella Mr.Jhonlery Sumabong	Preliminary setting of data-loggers and GSM modems and functional test
13 July	Mr. Erie Estrella Mr.Jhonlery Sumabong	Preliminary setting of data loggers and GSM modems and functional test
14 July	Mr. Erie Estrella Mr. Karl Maestrado (ITC)	Final coordination on telecommunication test procedures between the sites and PAGASA with site ID

19 October	Mr. Michael Bala Mr. Ramjun Sajulga	Improvement for radar data calibration with AWS

Table 3-3-5 Lecture and exercise

Date	Title	Contents
13 November 2014	Basics of SATAID usage (lecture)	Basics of SATAID usage and how to display PAGASA-AWS data with SATAID
27 February 2015	RADAR product usage, QPE and QPF	RADAR products and their usages, QPE (Quantitative Precipitation Estimation) and QPF (Quantitative Precipitation Forecast)
20 October	Pick up station data from R1 product	A lecture for software to pick up station data from square grid data.
13 December	PPI data composition and rain intensity calculation	A lecture for software to compose PPI data and calculate rain intensity.
15-19 February 2016	Satellite and SATAID usage	Trainings for usage for HIMAWARI8 data, usage for SATAID and Dvorak methods
13-17 June	Mr. Michael Bala Mr. Ramjun Sajulga	Development and improvement for radar data calibration with AWS
19-25 October	Mr. Michael Bala Mr. Ramjun Sajulga	Improvement for radar data calibration with AWS

(3) Outcomes

- Materials for the lecture (Basics of SATAID) (November 2014)
- Survey report on the real-time meteorological data at PAGASA (November 2014)
- RADAR products, QPE and QPF (February 2015)
- Scripts for RADAR image movie (July 2015)
- Software for PPI composition and rain intensity calculation (December 2015)
- Technical Instruction Materials for SATAID, HIMAWARI-8 data, Duvorak Analysis (Feb. 2016)
- Memorandum of JRC radar analysis (June and October 2016)

(4) Collected materials

Documents	Contents	Source
Historical data and station list of RADAR, AWS and ARG	RADAR data at Appari and Virac, AWS/ARG data (14 Sep. 2014) and a station list	Mr. Harry Alcantara (ICT)

RADAR AWS/ARG data	Low level PPI data at 3 Radar sites. ARG/AWS data since June 2015	PAGASA_D/B

3. 3. 4 Issues to overcome and the points devised in the activities

(1) Setting objectives

The objectives for activity of SATAID usage were as follows.

- Enhance satellite analysis skills and promote SATAID usage through JMA short-term experts training in February 2016.
- Develop software and scripts for operational use of radar, AWS/ARG and satellite data composition using SATAID.

. The objectives for activity of radar product were as follows.

- Develop software to compose lower 3 PPI data of Aparri, Virac and Guiuan radar and calculate rain intensity.
- Install ARG (Automated Rain Gauge) network in southern Luzon Virac radar covering area and start real time rain gauge data observed by calibrated rain gauges.
- Develop software and scripts for operational use of radar data calibration with AWS data.

(2) Technical Working Group

Working Group for RADAR is composed of 3 staff members from R&D section and 2 from Weather Forecast Section, who implement collection of data and comparison research. Members in December 2015 are Mr. Michael Bala, Mr. Ramjun Sajulga and Ms. Maria Ana Glaiza Escullar.

Working Group members for SATAID are Dr. Palcon and Mr. Raymond of weather forecast section, and the working group implement Himawari-8 training and develop software to compose radar and AWS data on satellite images.

(3) Expected results

Expected outputs through this activity are as follows

* Radar data will be calibrated with AWS and ARG data
* Enhance monitoring capability through monitoring radar data with SATAID,
* Enhance weather forecaster ability through trainings regarding satellite data.

3. 3. 5 Achievement situation of the result

Table 3-3-6 Level of achievement with reference to Indicators (Output 2a)

Indicators as per PDM (version 1)	Major achievements	Remarks
2-1 Capability of 80% of the operational staff on the use of SATAID is improved.	● Project conducted various trainings such as SATAID, Dvorak method, Himawari 8. The short-term experts reported that there had been improvement of staff's capacity. ● 22 staff participated in the above-mentioned training, and it is reported that more than 80% of them enhanced knowledge on the use of SATAID after the training.	● Staff are already utilizing SATAID, the Project only provided additional knowledge through trainings and mentoring.
2-2 Software for RADAR data calibration with raingauge data is developed.	● Software for Radar data calibration with rain gage data is developed. ● Continuous archiving of available radar and raingauge data since Dec 2015. ● Installation of additional 9 ARGs around Virac radar.	● The software has been evaluated with data during heavy rain events and awaits for more events to be able to feed into the system. ● In order to develop QPE system, it is necessary to i) archive Radar and AWS/ARG data; ii) assure quality control of Radar data through capacity-building of numerical modeling staff; iii) calibrate radar data with ARG data. ● Recommendation for the observation angle mode of Virac radars is reported.

Short-term experts were dispatched to provide trainings on the use of SATAID and it is reported by the short-term experts that there had been improvement of staff's capacity on the use of SATAID (indicator 2-1). For the calibration of radar data, Radar data from Aparri, Virac and Guiuan are transmitted to PAGASA central office and the ARG data is transmitted to both PAGASA central office and SL-PRSD. Rainfall data from Radar and AWS/ARG are reported to have been archived from July 2014. However, Japanese expert team notes that rainfall data are still not enough even after the

mentioned date of July 2014. Development of QPE is partly tested, since it requires to i) archive Radar and AWS/ARG data; ii) assure quality control of Radar data; and iii) calibrate radar data with ARG data.

3. 3. 6 Recommendations for achieving overall goal

(1) Indicator 2-1 [SATAID]

PAGASA installed satellite data receiving system and data collection system from JMA satellite data server for their operation. And through the trainings in February 2016 for new satellite HIMAWARI8, Dvorak methods and SATAID usage for staff members in weather forecast division enhanced their knowledge for satellite products. Additionally software and scripts for transforming radar and AWS data for overlaying on satellite data were developed. PAGASA is using SATAID in daily tasks and hopefully in future PAGASA would better monitoring radar and AWS data with overlaying satellite data. And ideally, the team on satellite analysis could be established as discussed at the end of the training in February 2016, and through the activities of the team technical capacity would be continuously improved.

(2) Indicator 2-2 [RADAR data calibration with rain gauge data]

For the development of RADAR rain intensity calibration and QPE (Quantitative Precipitation Estimation), southern Luzon raingauge network was constructed in July 2016. And 10 minutes interval precipitation data were obtained stably. Software and scripts for preliminary QPE were also developed and tested in June and October 2016.

For the development of QPE, it will heavily rely on the availability of rainfall and radar data. It is necessary for PAGASA to assure if the data from all 9 ARGs and radar data are appropriately transmitted and archived at PAGASA central office. And using rain gauge and radar data during heavy rain events, the preliminary processes of QPE would be tested and improved.

3. 4 OUTPUT 2-b (Weather Guidance)

3. 4. 1 Project Purpose

(1) Output and indicators should be attained

[Output] 2 Capacity on meteorological data analysis and forecasting is improved.

[Indicator] 2-3 Weather guidance is developed

(2) Activities

2-3 Provide training on Weather guidance (Model Output Statistics)

3. 4. 2 Issues identified in the baseline survey

In September 2014, the baseline survey was implemented on forecast operation of PAGASA and on the current status of data acquisition and data archive required for the development of weather guidance.

The following issues were identified in the baseline survey.

(1) Current status of forecast operation

Positive indications	• Official weather forecast up to 5 days ahead is issued twice a day through the web site and other media. The forecast includes quantitative elements such as maximum temperature and minimum temperature of a day. • In the process of making weather forecast, NWP product from other countries, own NWP product of PAGASA, meteorological satellite image and radar data are used.
Challenges	• The process of making weather forecast is fully manual and it deeply depends on the subjective judgment of the forecaster. • No quantitative work support materials for the forecasters such as weather guidance.
Cause and analysis	• In order to create and issue accurate forecast efficiently, it is necessary to establish a forecast work system in which the operations are based on the quantitative objective work support data such as weather guidance. • For this purpose, an appropriate guidance method such as MOS should be developed. However, technology necessary for this is insufficient under the present conditions.

Counter-measures	[Technical aspect] The new forecast work system can be realized by developing NWP-based weather guidance and providing forecasters with the guidance. [Human resources aspect] It is necessary for the PAGASA staff to attain abilities of development of weather guidance. The technical staff of PAGASA have enough potentialities for this purpose. PAGASA will become able to develop weather guidance by themselves, by bringing up the technical staff by appropriate training support. [Organizational aspect] It is desirable for PAGASA to expand the section which can devote itself to technology development which is required for the improvement of forecast work.

(2) Status of observation data archive needed for the development of weather guidance

Positive indications	• Daily data of Synop observation is archived in digital format. • Tmax and Tmin data needed for the development of weather guidance are available. • 3-hourly data of Synop observation are archived in WMO code format. • High frequency AWS and ARG data such as hourly data are archived in digital format.
Challenges	• More frequent Synop data than daily data (in WMO code) cannot be handled with a computer directly. • AWS and ARG data are not arranged for a unified database.
Cause and analysis	• Computer readable database is developed insufficiently.
Counter-measures	[Technical aspect] It is desirable to give priority to digitization work, under the recognition of the importance of digital data for the improvement of many fields of work.

(3) Status of GPV data archive that is needed for development of weather guidance

Positive indications	• Low-resolution GPV data (1.25 deg.) is downloaded from JMA WIS server and the map of that is used in the forecast operation. • Downloading and archiving of high-resolution GPV data (0.25 deg. at surface data, which is the base of development of weather guidance) started in September 2014.

Challenges	• Archive time range of the high-resolution GPV data is insufficient for the development of weather guidance. • Upper atmosphere GPV data, which is needed for the improvement of weather guidance, is not downloaded.
Cause and analysis	• The necessity of the high-resolution GPV was recognized after start of activities of weather guidance development. • The storage capacity is insufficient for archiving the large amount of data of 3-dimensional upper-atmosphere GPV.
Counter-measures	[Technical aspect] • PAGASA should continue downloading high-resolution GPV in order to get long-term archive which is sufficient for the development of weather guidance. It is expected that the data necessary for temporary use is provided by JMA. • It is desirable that large-capacity archiving device is equipped in order to store upper-atmosphere GPV data.

3. 4. 3 Outline and outcomes of activities

(1) Outline of activities

In September 2014, a baseline survey was implemented on the current status of forecast operation of PAGASA and the status of data acquisition and data archive required for the development of weather guidance. Through the survey the issues presented in Section 3.4.2 were recognized.

In November 2014, technical trainings in weather guidance started.

Through the trainings during 4 times visits of the expert from February to August 2015, the techniques on production of weather guidance and on verification of it were transferred to PGASA staff. And the results of the experiments using the techniques indicated that the guidance would be able to greatly improve the accuracy of issued forecast of PAGASA.

After September 2015, TWG have developed automated production system of temperature guidance to support actual weather forecast work. Until November 2016, the system was completed and has been used for the daily forecast work successfully from 8 December 2016.

(2) Specific activities

Implementation of training in Weather guidance

(a) September 2014

During the stay, an introductory lecture for 14 staff members of PAGASA was conducted for the purpose of transfer of knowledge about necessities and development procedures of the weather guidance.

(b) November 2014

A 'Technical Working Group (TWG) on Weather Guidance' was formulated by 5 staff members of PAGASA and the training for the members started.

At first, the purpose of the project was reconfirmed in the TWG. The members agreed that the goal of the work of the TWG was development of the weather guidance to support the official forecast issued twice a day. As the first step to achieve this goal, trainings in how to make the guidance in order to predict the maximum temperature were conducted 5 times in November 2014.

After the series of trainings in November 2014, a meeting of chief forecaster and the TWG was held. In the meeting the status of progress on development of weather guidance was reported. The plan to use weather guidance in operational forecast was proposed and views were exchanged.

(c) February-March 2015

More advanced technique of producing weather guidance, i.e., "Kalman filtering", was studied by the TWG. As part of training, simulation forecast experiments were executed. As a result, it was noted that the weather guidance developed in the training had practical accuracy up to 6-day forecast at the location of PAGASA headquarters (Science Garden).

A meeting was also held between the TWG and the technical group in charge of the development of forecast work support system. In-depth discussions were made on how to use the weather guidance in the future operational forecast work.

The outcomes of the technical development from November 2014 to March 2015 are summarized in a technical report "Technical Progress Report on the Development of Weather Guidance in the Philippines (No. 1)"(attached as Reference - 4). The report was distributed to the staff of PAGASA and concerned experts in Japan.

(d) May and July 2015

A practical training in simulation temperature forecast experiments was conducted for 5 main cities in the Philippines. The practice was executed as group work of the TWG. The result of the verification of the simulation experiments showed that the guidance with better accuracy than that of the currently issued forecast could be developed for all 5 locations and for all seasons.

(e) August 2015

A meeting entitled "Technical Presentation on the Development of Weather Guidance" was held by the TWG, where the process and result of the development of weather guidance and the future plan on its utilization were reported to many staff members of PAGASA. The technical results reported in the meeting were summarized in "J-POW Technical Progress Report on Weather Guidance No. 2" (attached as Reference - 6) and the report was distributed to the staff concerned.

As the potential usefulness of the temperature guidance was confirmed, after September 2016, the activity of the TWG focused on the development of automated production system of temperature

guidance to support actual weather forecast work.

(f) January and April 2016

The programs for the automated production system of temperature guidance were developed and the good accuracy of the simulation forecast by using the program was confirmed, although the newly developed program was simplified compared to the program used in the experiment in 2015. A lecture on the quality control (QC) processing of the observation data, which is important in the real-time processing, was conducted and the practice of making programs of QC was also conducted. The QC procedures were based on comparison with climatological value and comparison with predicted value by the guidance. The QC programs developed in the training were introduced into the automated production system.

(g) May-June 2016

Training was conducted that makes the production system of weather guidance for the early morning forecast (issued at 05PST) which was based on the NWP from 12 UTC initial value (*1). Based on the result of this training, the TWG started the internal test (*2) of everyday production of the temperature guidance by the system at mid-June 2016.

(*1) PAGASA issues weather forecast twice a day, early morning (05 PST) and evening (17 PST). Temperature guidance of two times must be prepared in order to support these forecast works. The guidance for the early morning forecast is based on the NWP from 12 UTC initial time, and another for evening forecast is based on that of 00 UTC initial time.

(*2) Internal test: the semi-real-time execution test for the purpose of confirmation of stable execution and good accuracy of new system, which is evaluated mainly within the TWG.

(h) September-October 2016

Training was conducted that makes the production system of weather guidance for the evening forecast (issued at 17PST) which was based on the NWP from 00 UTC initial value. And JICA expert and TWG explained about the status of achievement of the purpose of the project to Terminal Evaluation team.

Although the system was not fully completed within the stay term of JICA expert in October, the system was completed in November 2016 by the counterpart of PAGASA, and internal test of full function system was conducted. The full environment of operational use of temperature guidance was prepared, by integrating the guidance product into FAST system.

(i) December 2016

On 7 December 2017, IEC (Information and Education Campaign) meeting was held by the counterpart in order to explain about the start of the use of temperature guidance in daily forecast work. After the meeting, the temperature guidance started to be used in the operation of forecast.

(j) February 2017

The evaluation of the temperature guidance which was already used in operation started in the TWG. Lectures and practices on the basic technique of the guidance of meteorological element other than temperature (rainfall amount, POP and wind) were also conducted. New 2 members of forecast division joined to the TWG for these trainings.

(k) April 2017

The evaluation of the temperature guidance which has been used in operation continued. A lecture about the more practical trial of POP guidance experiment, that is 5 day forecast POP, was conducted.

The activity result of output-2b and the accomplishment of the project purpose indicator 2 was reported to the final JCC.

A list of meetings and interviews is given in Table 3-4-1, and that of trainings in Table 3-4-2.

Table 3-4-1 List of Meetings and Interviews

Date	Attendee	Contents
2 September 2014	4 C/Ps	Explanation of the plan summary of output 2-3 Items of baseline survey and request for cooperation
3-5 September	Interview survey to sections concerned with a C/P	Visit survey to the operation room of forecast division concerning the forecast operation procedure Interviews to the following sections on the status of data archive, etc. which are necessary for the development of weather guidance - Weather Division TAMSS (Techniques Application and Satellite Section): Survey on the status of collection, processing and archive of NWP data - CDS (Climate Data Section): Survey on the status of archive of historical observation data of PAGASA's stations - ICS（Information Communication Section): Survey on the status of data archive of AWSs (Automated Weather Stations) - High performance computer room: Survey on the status of archive of output of PAGASA's high-resolution NWP model
11 September	4 C/Ps	Future plan of training in making weather guidance Preparation for the next training
6 November 2014	5 members of TWG on	Explanation of the training plan in November Information sharing of activities after the last visit

	Weather Guidance	Adjustment of the schedule of the group training
26 November	Chief forecaster and a C/P	Status report about the training in making weather guidance Explanation about outlook of the development of weather guidance Proposal of TWG on the usage of weather guidance in operational forecast, and exchange of views
26 November	5 members of TWG on Weather Guidance	Confirmation of the result of the Training. Discussion on the future training and development plan Confirmation of the preparation work in PAGASA for the next training
9 March 2015	4 members of technical group on forecast work support system	Discussions on how to use the weather guidance in the future operational forecast work
12 May 2015	3 members of TWG	Discussion on the schedule of activity during the stay in May Discussion on the preparation of semi-automation system
19 May	Mr. Sato, J-POW expert, and 2 PAGASA staff	Discussion on data needed for output2a, output2b and output3 Discussion on construction of data transfer system (members of QPE TWG and Guidance TWG joined)
21 May	5 members of TWG	Summary of development of temperature guidance for 5 main cities Discussion on plan of technical report meeting for PAGASA staff
7 July 2015	5 members of TWG	Discussion on the schedule of activity Discussion on the preparation of "Technical report meeting"
16 July	5 members of TWG	Discussion on the self-work for preparation of "Technical report meeting" Design of semi-automation system for weather guidance Plan for the next training
14 August 2015	Dr. Cayanan, C/P of output-2b	Prior explanation on the technical presentation to the chief of Weather Division Discussion on the usage of weather guidance in the forecast operation

Table 3-4-2 List of Trainings in Weather Guidance

Date	Lecture, Practice	Contents
9 September 2014	Open Lecture (14 participants in PAGASA)	Lecture on "Introduction to MOS guidance" Basic concept of weather guidance was explained and the participants experienced data processing of weather guidance on PCs.
6 November 2015	Lecture and Practice for 5 members of TWG	Introduction of R language for development of weather guidance (the statistical processing programing language, which would be used in the training)
7 November	Practice for 2 members of TWG	Data preparation for guidance calculation
17 November	Lecture and Practice for 5 members of TWG	Procedures for making guidance using R (How to make MOS guidance for Tmax of the next day at LEGASPI)
21 November	Practice for 5 members of TWG	Let's make 5 days forecast guidance (How to make MOS guidance of Tmax for 5 days forecast at LEGASPI)
24 November	Practice for 5 members of TWG	Let's make guidance for Science Garden (MOS guidance for Tmax at headquarters of PAGASA and study on the issues to be improved)
5 March 2015 (am)	Lecture and Practice for 5 members of TWG	Introduction of Kalman filter (more advanced technique of producing weather guidance)
5 March (pm)	Practice for 5 members of TWG	Tmax guidance of the next day forecast at Science Garden using Kalman filter technique
6 March (am)	Practice for 5 members of TWG	Temperature guidance up to 6-day forecast (following practices during March were on Kalman filter technique)
6 March (pm)	Practice for 5 members of TWG	Tmin guidance and home work for the TWG (the self-work to be done after the expert left PAGASA)
12 May 2015	Practice for 5 members of TWG	Group work on development of temperature guidance for 5 main cities in Philippines
13 May	Practice for 2 members of TWG	Group work on development of temperature guidance for 5 main cities in Philippines
14 May (am)	Lecture and Practice for 5 members of TWG	Lecture and Practice on development of temperature guidance for 5 main cities
14 May (pm)	Practice for 2 members of TWG	Group work on development of temperature guidance for 5 main cities in Philippines

20 May	Lecture for 4 members of TWG	Lecture on "design of weather guidance producing routine system"
6 July 2015	Lecture for 5 members of TWG	Lecture and discussion on "Improvement of forecast accuracy and evaluation"
9 July	Practice for 5 members of TWG	Discussion on the results of forecast experiment for 5 main cities in Philippines
10 July	Practice for 5 members of TWG	Discussion on the presentation of "Technical Report meeting"
14 July	Lecture for 5 members of TWG	Lecture and discussion on "Importance of QC of base data of experiment"
15 July	Practice for 5 members of TWG	Design of semi-automation system for weather guidance
10 August 2015	Practice for 5 members of TWG	Discussion on the activity schedule and the results of forecast experiment for 5 main cities Discussion on the design of semi-automation system of weather guidance
12 August	Practice for 5 members of TWG	Discussion on the schedule of activity Discussion on the programme of "Technical Presentation"
13 August	Practice for 2 members of TWG	Group work on construction of semi-automation system
17 August	Practice for 5 members of TWG	Discussion on the programme of "Technical Presentation" Discussion on the design of semi-automation system
18 August	Practice for 5 members of TWG	Rehearsal of the Technical Presentation Discussion on the future plan and the next training
20 August	**Technical Report meeting with 25 participants** (members of TWG and PAGASA staff)	**"Technical Presentation on the Development of Weather Guidance"** (where the process and result on the development of weather guidance during this 10-month period and the future plan on its utilization were reported by the TWG members)
26 January 2016	Lecture for 5 members of TWG	Lecture on "Practical consideration of the system structure of routine system" and discussion about the construction of automated production system of weather guidance
27 January 2016	Practice for 5 members of TWG	Practice on QC (quality control) processing of weather guidance producing system
25 April 2016	Practice for 3 members of TWG	Practice on QC processing; Statistical analysis of the error distribution of guidance forecast

2 June 2016	Practice for 5 members of TWG	Practice on the automated production system of Tmax forecast guidance for 15 stations in Philippines
9 June 2016	Practice for 5 members of TWG	Practice on the automated production system of Tmin forecast guidance for 15 stations in Philippines
26 September 2016	Technical discussion with 3 member of TWG	Construction of automated guidance production system (discussion on the latest status)
27 September	Practice for 3 members of TWG	Construction of automated guidance production system (preparation for the long time Kalman cycle execution)
3 October	Practice for 3 members of TWG	Construction of automated guidance production system
5 October	Practice for 5 members of TWG	Group practice on the test run and verification of automated guidance production system
10 October	Technical discussion with 3 member of TWG	Discussion on the progress of the construction of automated guidance production system
17 October	Technical discussion with 3 member of TWG	Discussion on the automated guidance production system and development plan
7 December 2016	Technical explanation meeting for forecasters with 39 participants	**IEC (Information and Education Campaign) meeting for forecasters** to explain about the start of the use of temperature guidance in daily forecast work (lectured by the counterpart of PAGASA)
7 February 2017	Technical discussion and practice with 2 members of TWG	Evaluation of the temperature guidance which was already used in operation (1)
8 February	Technical discussion with 5 members of TWG	Introduction meeting with new members of TWG (Discussion about the activities and result until now)
14 February	Lecture and Practice for 7 members of TWG	Lecture and practice about Rainfall amount guidance
16 February	Lecture and Practice for 7 members of TWG	Lecture of POP and wind guidance and practice of POP (Probability of Precipitation) guidance.

17 April	Lecture and discussion with 6 members of TWG	Discussion on the evaluation of the temperature guidance, Lecture on the 5 days forecast POP and discussion on the future plan.

(3) Outcomes

- Trial forecast equation of weather guidance, which has been developed in the training of the TWG, and the result of verification of the equation (Reference - 1)
  (The equation is for the prediction of up to 6 days ahead at Legazpi)
- J-POW Technical Progress Report on Weather Guidance No. 1 "Technical Progress Report on the Development of Weather Guidance in the Philippines - Report of the progress until March 2015 -" (Reference - 4)
- Presentation materials in "Technical Presentation on the Development of Weather Guidance" (held on 20 August 2015) (the main results are shown in Reference - 5.
- J-POW Technical Progress Report on Weather Guidance No. 2 "Development of Temperature Guidance for 5 Main Cities in the Philippines - Result of Activities from May to August 2015 -" (Reference - 6)
- J-POW Technical Progress Report on Weather Guidance No. 3 "Automated production system of temperature guidance for forecast operation of PAGASA - Result of Activities after January 2016 -" (Reference - 7)
- J-POW Temperature Guidance Automated Production System Operations Guide (Reference - 8)

(4) Collected materials

Table 3-4-3 List of collected materials

Title of data or document	Contents	Providers
Documents of official forecast issued twice a day	The original files of the issued forecast for more than 15 months were provided. (a sample is in Reference - 2)	PAGASA
Data of Tmax and Tmin at 5 cities	Daily data of Tmax and Tmin at 5 cities for 2 years were provided. (a sample is in Reference - 3)	PAGASA
Grid Point Value of JMA's global NWP model	Data for 23 months (from Jan. 2013 to Nov. 2014) were collected. The data volume was about 400 GB. GPV data for the period before September 2014 (21 months) was provided by JMA.	JMA and PAGASA

3. 4. 4 Issue to overcome and the points devised in the activities

(1) Setting objectives

The activity of this output will be implemented as follows.

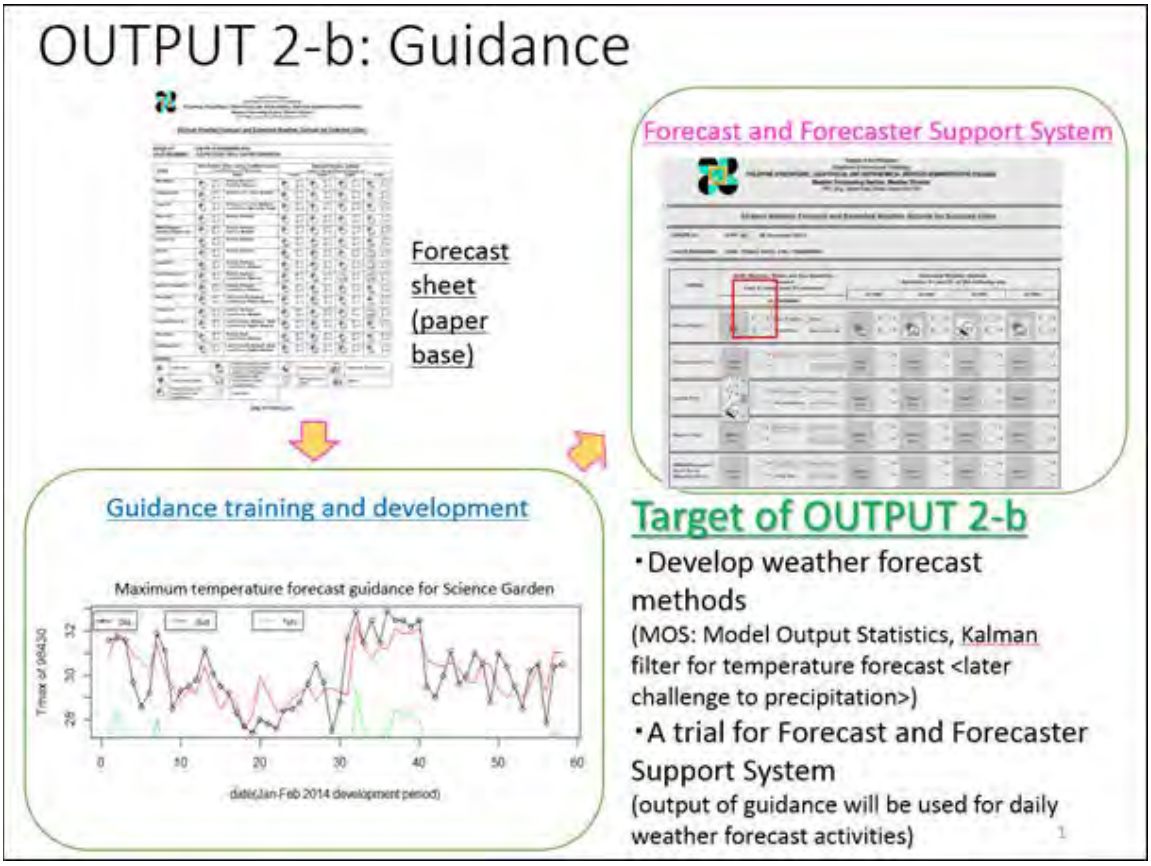


Figure 3-4-1 Activity image of the output

(2) Technical Working Group

Five technical working group (TWG) members were assigned by PAGASA in November 2014. The activities in this output are implemented through discussions with the TWG members. The achievements of the activity will be reported to the officers as needed.

Additional two members joined from the training of February 2017.

Table 3-4-4 TWG membership (Weather Guidance Group)

Name	Section/Division
Mr. Raymond C. Ordinario	TAMSS, WD
Ms. Samantha Christine V. Monfero	TAMSS, WD
Mr. Resly George Q. Amador	TAMSS, WD
Ms. Shirley J. David	NMS, RDTD
Mr. Larry Ger B. Aragon	NMS, RDTD

Mr. Robb P. Gile (from February 2017)	MMSS, WD
Mr. Darwin R. Alejos Jr. (from February 2017)	TAMSS, WD

(3) Expected results

Expected improvement of forecast operation

The forecast operation of PAGASA will be improved as follows by utilizing result of the technology development activity for output 2-b (weather guidance):

- Quantitative objective work support data (weather guidance), which is based on numerical prediction, will be used in daily forecast operation.
- By the use of weather guidance, efficiency of the forecast work and the accuracy of quantitative forecast issued by PAGASA will be improved.
- By the use of weather guidance, the quality of issued forecast would be assured (without relying on the individual forecaster's skills)

Expected capacity building

Through technical training activity for output 2-b (weather guidance), capacity building of PAGASA will be enhanced as follows:

- The members of 'TWG on Weather Guidance' will not only get the technical training but also will experience the whole process of making practical weather guidance which is used in actual operation. Through this activity, they will obtain the ability to develop the weather guidance by themselves.
- The application technique of NWP GPV is crucial for improvement of forecast service of PAGASA. Based on the work of the TWG, these talented staff will become the core of the technical staff who could create a variety of information required by the Philippine society.

(4) Insufficient data availability

Table 3-4-5 Challenges in executing the work

	Lack of data needed for the development of weather guidance
Challenges	Observation data and GPV data of JMA NWP are required for the development of weather guidance. PAGASA started archiving NWP data, but the archive period was insufficient.
Countermeasures	JMA provided the project with NWP data for the past 3 years. The trainings were conducted using this NWP data and observation data provided by PAGASA.

(5) Points devised in conducting the training

Following points were devised for the effective training:

- Training directly usable in the actual work

There are many cases that the training ends in just learning and the knowledge acquisition. It was noted that skills attained from the training were usable in actual work.

In particular, the actual data of representative cities in the Philippines were used as the teaching materials of the training from a stage of basic practice so that the trainees could easily understand and make the practical use. After the training, a meeting with the representative of the operational work section and the development group was held and a consensus about practical use of the guidance was obtained.

- Training containing a lot of practice

There are many cases that trainings are given mainly in the form of classroom lecture. It was noted that trainings were given mainly in the form of practical study.

In particular, the trainings were conducted so as to contain many practical studies and minimum classroom lectures. The trainees experienced actual data processing on their PCs. Their understanding on the technique was deepened through a group discussion in the TWG.

3. 4. 5 Achievement situation of the expected results

(1) Indicator 2-3 Weather guidance is developed

The 5 members of TWG (since November 2014) had received training on the technique of weather guidance, and they had developed temperature guidance based on the Kalman filter technique by August 2015. The result of simulation forecast experiment conducted by the TWG showed that the accuracy of their temperature guidance was far better than that of currently issued forecast of PAGASA.

The TWG members received the trainings about basic technique of guidance making of meteorological elements other than temperature also, such as rainfall amount, POP and wind, and they understood the technique.

These facts show that "The Indicator 2-3 was accomplished".

(2) Project purpose indicator 2. Quantitative forecasting is issued by using weather guidance

After September 2015, the TWG has constructed the automated production system of temperature forecast guidance, which was needed for issuing daily quantitative forecast by using weather guidance. They have proceeded their development work toward the completion until the end of 2016

At the time of Terminal Evaluation of October 2016, TWG reported the entire system was planned to complete within 2016. And it was remarked in the Terminal Evaluation Report that "It is important to steadily complete the "automated production system of weather guidance" and FxWSS based on the implementation plan agreed between JICA expert and PAGASA counterparts." (FxWWS was the name of forecast work support system, and renamed as FAST (Forecast Assist Tool) after.) After the Terminal Evaluation, within November 2016, the automated production system completed, and the temperature guidance was integrated into FAST.

On 7 December 2016, IEC (Information and Education Campaign) meeting was held by PAGASA

counterpart in order to explain to forecasters about the start of the use of temperature guidance in daily forecast work. After this meeting, the temperature guidance started to be used in the operation of forecast.

The temperature guidance have been used for issuing quantitative forecast (temperature forecast) of PAGASA successfully.

These facts show that "The Project purpose indicator 2 was accomplished".

(3) Summary of the result

TWG members have experienced the full processes of temperature guidance development, such as study of basic knowledge on the technique of Kalman filtering, evaluation of potential performance of the developed guidance by forecast simulation experiment, design of the automated production system for the operational use and the construction work of it. And they learned basic guidance technique of the meteorological elements other than temperature also (Rainfall amount, POP and wind). They obtained the basic abilities for the development of weather guidance by themselves through these activities. (The process from the development to operational use of weather guidance is shown in Figure 3 - 4 - 2.)

It is hoped that the PAGASA side will further develop the weather guidance by themselves based on the techniques transferred through this project to meet requirements for practical forecast operation of the Philippines.

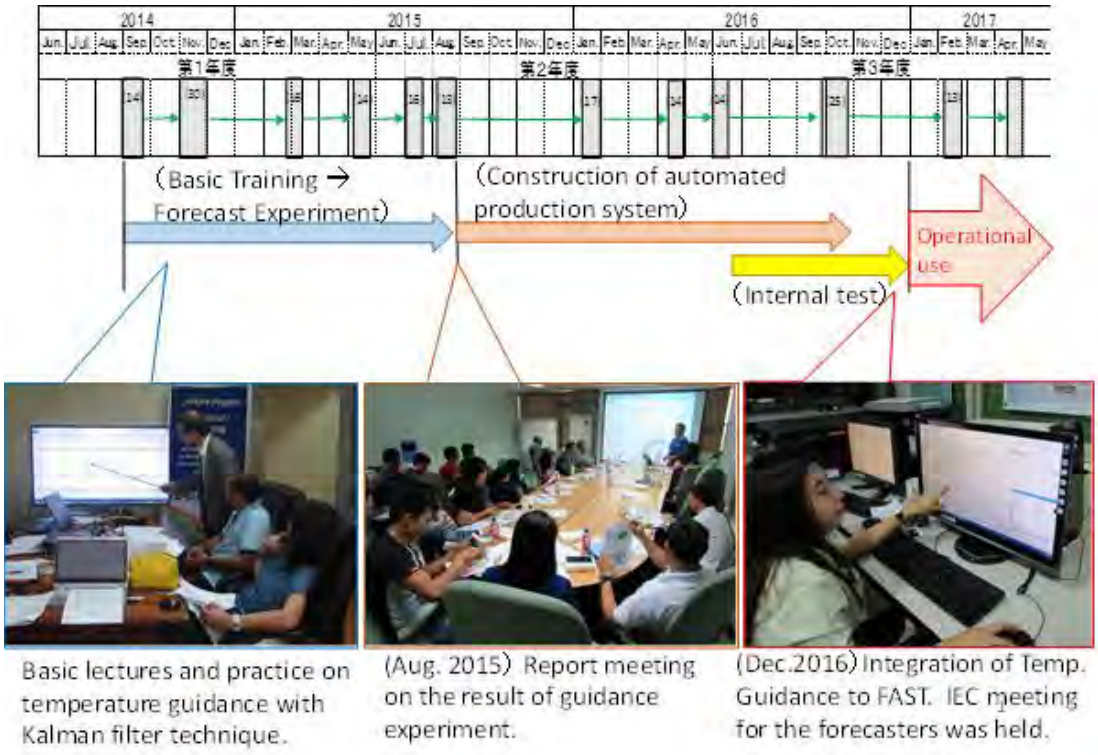


Figure 3-4-2 The process from the development to the operational use of weather guidance.

3. 4. 6 Recommendations for achieving the overall goal

In order to achieve the overall goal “Capacity of all PRSDs is enhanced in terms of weather observation, forecasting and warning” based on the result accomplished by this project, continuous effort of development and utilization of weather guidance would be one of most important factors.

It is because that the utilization of weather guidance, which realize the various meteorological prediction information to the public by little man power effectively, would be inevitable to improve the forecast service which meet a variety of requests of the nation. And the weather guidance, which is match the meteorological situation of Philippines and directly support the forecast work of PAGASA, must be developed by itself.

To accelerate the above mentioned activities, followings are recommended.

(1) The activities of the technical working group of weather guidance should be continued after the closing of this project.
(2) The short-middle term technical development plan should be made considering the strong relationship with the improvement plan of PAGASA's service.
(3) The workload of operational forecasters would be reduced by introducing the NWP-based objective forecast support materials, but new large manpower for the development of and managing the automated production system would be needed. More number of high-level technical staff should be fostered and should devote themselves to the specialized work.

3. 5 Output3 (Criteria of warnings are elaborated at Southern Luzon PRSD)

3. 5. 1 Project Purpose

(1) Outputs and Objectively Verifiable Indicators

[Output] 3 Criteria of warnings are elaborated at Southern Luzon PRSD.

[Indicator] 3-1 Criteria of warnings are made at the provincial level.

(2) Activities

3-1 Conduct survey on current situation of warning and identify their challenges.

3-2 Elaborate methods to improve warnings and make criteria of warnings based on the above findings.

3. 5. 2 Issues learned in the base-line survey and meetings

The base-line survey was conducted at weather stations in PAGASA CO, NCRPRSD and SLPRSD and at various disaster prevention organizations. Consultation meetings on Disaster Risk Reduction were held at three targeted provinces, that is, Albay, Sorsogon and Northern Samar provinces. Chief of Weather Division, Acting Chief of SLPRSD and representatives from PDRRMO and City/Municipality DRRMOs took part in the meeting.

Following issues were recognized through the baseline survey and other meetings.

(1) Criteria of warnings and some issues on announcement of warnings

Positive indications	PAGASA has experience of issuing 'Heavy rain warnings' in NCR PRSD and Visaya PRSD. It should be noted that the experience of operational warning issuance is short and it started on 20 June 2012. The criteria for heavy rain warning is "more than 30mm of rain is observed for the past hour or rainfall more than 65mm has been observed for the past three hours, and expected to persist in the next 3 hours" The criteria was established by comparing flood data collected at MMDA and rainfall observed by PAGASA in consultation with the staff at Hydomet Division of the PAGASA Central Office. Due to low drainage capacity, the metropolitan area is prone to inundation by short time heavy rainfall. This is why the threshold s was set at 30mm/hour. Operationally, 15mm in 30 minutes and 7.5mm in 15 minutes are also monitored to issue warnings. In SLPRSD, flood data from NDRRMC archives and flooding movies archived in YouTube were collocated with six hourly observations made at Legazpi station. It is a tentative warning criteria to be issued to Legazpi city and surrounding municipalities. The criteria is more than 100-120mm in the past 30 hours and more than 40mm in the past 6 hours. Issuance of heavy precipitation warning was ready in June 2015.

	There were not many meteorological disturbances that brought about rainfall amounting to warning criteria in 2015 and 2016. On 27-28 February 2017, the author visited SLPRSD with Chief of the Weather Division and three other PAGASA staff and had consultation meeting with the staff of SLPRSD. According to the forecaster's presentation, typhoon Nona (Melor) landed on Eastern Samar island in December 2015 and the rainfall reached advisory criteria of heavy rainfall in Legazpi city. In 2016, the effect of El Nino continued and the number of typhoons affecting the Philippines islands were not many and the issuance of heavy rainfall warnings were rare. On 24 December 2016, level 3 severe tropical storm Nina approached Catanduanes island where Virac radar was installed, and passed over Southern Luzon and caused 34 deaths and missing persons. SLPRSD issued advisory for heavy rainfall. However, due to power failure caused by the strong wind, SLPRSD failed to issue warnings, because the staff could not get access data such as radar images and rainfall data and lost the communication measures. The necessity of drawing up contingency plans according to various emergency situations were discussed. According to the presentation of a staff who was present at the seminar from the Hydromet Division of PAGASA Central office, warnings for heavy rainfall are targeted to the areas which are not covered by flood warnings. For the southern Luzon region, flood warning is issued only for the Bicol river basin, which covers only limited areas of SLPRSD. Temporary criteria for heavy rainfall warning for other provinces were determined from the 3-hourly rainfall observation at SYNOP stations.
Issues to be solved	Heavy rain advisory, but not heavy rain warning, is issued in Mindanao PRSD. No heavy rain warning nor advisory are issued in Northern Luzon PRSD. In SLPRSD, warning criteria is established for Legazpi city and surrounding municipalities. In the other areas tentative warning criteria is established using rainfall observations at SYNOP stations. Setting up warning criteria for each province based on 3 hourly observed rainfall at SYNOP weather station, which is placed in the capital of each province, is similar to the situation of Japan Meteorological Agency in the 1950's and 60's. There are two issues. One of them is getting real time high resolution rainfall data. The radar images calibrated by surface rainfall is necessary. This is one of the output of this project, Output 2a「radar data calibration by surface rain gauges」. This is discussed in Output 2a. The other issue is to get local disaster data. The collaboration between PRSDs/weather stations and local governments are definitely needed.

Cause and analysis	Three hourly SYNOP rainfall data are available and archived at only SYNOP stations. Each region have usually one SYNOP station. There are some automatic weather stations(AWS) and automatic rain gauges(ARG) which measures rainfall every ten or fifteen minutes. However, they are not well maintained. The number of stations is not enough to calibrate weather radar images. This is the most serious issue in order to set up heavy rainfall warning criteria and actually issuing of heavy rainfall warning. Another issue is slow speed of internet. The radar images are transmitted to the Central Office via VSAT and forecasters at the CO are able to utilize the images on real time basis. However, those images are sent to SLPRSD via internet, but forecasters sometimes have to wait for tens of minutes to gain access to the images. The Virac radar images (reflectivity data) are not yet calibrated against ground based rainfall data, which is taken up in the activity 2.1(Training of methodology to calibrate radar data by using surface observation data) of this project. Warnings are forecasts, which always contain uncertainty and the decision to issue warnings is left to the duty forecaster. However, the decision should be objective as much as possible. The utilization of objective products on rainfall amount such as QPE (Quantitative Precipitation Estimation, calibrated radar reflectivity images by ground based rainfall observation), QPF (Quantitative Precipitation Forecast) is recommended.
Counter-measure	[Technical aspects] The proper maintenance and quality control (elimination of interferences, sea/ground clutters and noises on the images) of weather radars is a starting point for the successful calibration by ground based rain fall amount. For the Virac radar, scan angles should be modified in order to avoid ground clutters and sea clutters around the radar and to observe rain cloud close to the radar. The archive of rainfall observation from ARG/AWSs should be continued and its quality control should be carried out. [Organizational aspects] It should be commended that SLPRSD started to establish warning criteria for heavy rainfall by their own efforts. Rather than elaborating the warning criteria just established, I (long term expert) thought it better to take this opportunity and make the heavy precipitation warnings issued by SLPRSD better known to the public, as well as to enhance the collaboration between the PAGASA regional office and the DRRMOs in the province and city/municipality. The「Consultation Meeting on DRRM Collaboration」was held in Albay, Northern Samar and Sorsogon provinces.

	The Chief of the Weather Division, Officer-in-Charge of SLPRSD, Principle Meteorological Officer of weather stations as well as I gave presentations. The representatives from Provincial DRRMO and selected city/municipality DRRMOs also gave presentations on the best practices. Each meeting was participated by 25 to 40 participants. [Human resource aspects] Training of the PAGASA staff concerned with the activity 2.1 (calibration of radar images with observed rainfall on the ground) of this technical cooperation project should be given first priority. The staff should continue to develop QPE for the whole country by integrating the twenty planned weather as a next step after the completion of this project. In the longer term, the staff also should develop Soil Wetness Index and Runoff Index which has been developed in Japan Meteorological Agency using QPE/QPF products. The Soil Wetness Index and Runoff Index are indicators which quantify the possibility of landslides and flooding respectively. [External aspects] At the start of this project, the spatial dimension of meteorological phenomena that cause floods were not known. The effort to establish warning criteria for SLPRSD revealed that the floods are associated with heavy rainfall caused by synoptic disturbances such as low pressure area, tropical cyclones, tail end of cold front (TECF). This means warning criteria may be applied for a wide region, that is, provinces as a whole. It was found that local governments do not archive disaster records for more than a few years. However, in view of the large scale of the meteorological phenomena and the warning criteria is based on one day cumulative rainfall, issuing heavy rainfall warning for provinces (not cities and municipalities) is an allowable starting point. The disaster records archived at NDRRMC does not include local floods, but they are comprehensive, valuable and expected to be useful. PAGASA should collaborate with local governments to get weather related disaster data. [Other aspects] AWS/ARG data is being collected and archived. The continuation of the archive and the data quality should be confirmed.

(2) Insufficiency of detailed rainfall and disaster records

Issues to be solved	The detailed rainfall data and disaster records of enough spatial and time resolution are insufficient for the analysis on the criteria of the warning.
Cause and analysis	In order to analyze the criteria on warnings, rainfall amounts and associated disasters are compared. The following issues are addressed for further tuning of the warnings. - The collected disaster records have the date of the disaster occurrence but not the hour. It cannot be exactly collated with hourly rainfall data and the warning issuance time cannot be evaluated properly. -The place of the disaster records are recorded up to Barangays but the place should be identified as finer as possible, especially if landslides are target of warnings. - PAGASA have short duration (less than an hour) rainfall data by AWS/ARGs, but the number of AWS/ARGs is not enough to cover the whole country. - Online/real-time rainfall observations as well as radar images should be available to forecasters in the local offices who issue warnings. - There are some rainfall data observed by other organizations, but the accuracy is not guaranteed because instruments do not conform to WMO standards and the observation environment is not necessarily appropriate. - Sorsogon province DRRMO collects rainfall observations from 13 sites on real time basis. One of the observation site was visited and the rain gauge was small and it was placed on the eaves. Those rainfall observations may have small catchment rate and is not suitable for the purpose of warning issuance.
Counter-measure	[Organizational aspects] - Although the data acquisition and archive system for AWS/ARG rainfall data is established in PAGASA, real time as well as non-real time quality control management for automatic rain gauge (and other meteorological) data is recommended. [Human resource aspects] - Development of software for real time quality control of automatic rain gauge data is recommended. [External aspects] - PAGASA is established by presidential decree as a national agency which is responsible for issuing warnings on hydro-meteorological events. This is a mandate for PAGASA, but it does not exclude for other organizations/individuals to issue warnings.

	- The presidential decree does not specify in its provisions whether PAGASA has the authority on the quality assurance of meteorological observations carried out by national/local government agencies other than PAGASA. - Also the presidential decree does not state that PAGASA has the authority to collect all the meteorological observations carried out by national/local government agencies for the purpose of warning issuance. - To develop a legal basis on the assurance of quality and acquisition of meteorological observation data by PAGASA is a policy issue and may not be easy. Japanese legal framework (Meteorological Service Act, 1952) will be presented as an example. - A survey by JICA headquarter staff to each government agency on the aid to the Philippines, in view of the coming Presidential Election, was started. The first interview to PAGASA managers was conducted on January 13, 2016, and the following issues were requested to be taken up. #To establish PAGASA as a sole agency to issue meteorological and hydro-meteorological warnings. #To establish PAGASA as a sole government agency to assure quality of meteorological observations in the Philippines. #To establish PAGASA's authority to collect all meteorological observations within the Philippines for the issuance of warnings. #To establish PAGASA's authority in the issuance landslide warning (in collaboration DENR). [Other aspects] - The archived ARG rainfall data in Albay and Sorsogon provinces in 2014 were compared with six hourly Synop data and their quality was found of good quality.

3. 5. 3 Contents and results of activities

(1) Contents of Activities

A survey was conducted through interviews with the personnel at DRRMO, PAGASA personnel in CO and local offices, concerned people in JICA Philippines office. The environment and instruments of observation stations in NCR, Northern Samar, Sorsogon and Albay provinces were also studied.

In order to enhance the understanding on output3 「warning issuance on heavy precipitation by PAGASA」, consultation meeting with the personnel of DRRMO at local governments were conducted, and lectures and trainings were given at the request of PAGASA.

At the request of JICA Philippine office, a lecture on weather and disasters caused by weather in the

Philippines was given to JICA volunteers.

The following is a summary of the activities not only as an expert responsible for output 3, but as a long (May 2014~ May 2016) and short (May 2016~present) term expert from a broad perspective.

1-1 Severe Weather Bulletin and Public Storm Warning Signal

Weather Division of PAGASA issues Tropical Cyclone Warning Signal (TCWS) as severe weather bulletins when tropical cyclones approach to or within the Philippine Area of Responsibility.

The TSWS is classified into five categories in accordance with the maximum sustained wind speed (10 minutes mean wind speed) of the tropical cyclone and the temporal proximity of the center of the tropical cyclone and the affected provinces. In May 2015, the fifth category was added as a super typhoon whose maximum sustained wind speed is more than 220km/hour.

In the severe weather bulletin, category of TCWS is given to each province. Also, the possible storm surge height and wave height* are indicated for each province to be affected. Flooding and landslides are alerted indicating rainfall intensity (15mm/hour: heavy rain and 30mm/hour: intense rain) around the center of tropical cyclones (say, 600km radius). The total amount of expected rainfall in the next 24 hours, which is directly related to the probability of floods and landslides, is not specified in the bulletin. Except for flood warnings for major rivers such as Bicol and Cagayan rivers, hourly rainfall amount is the only alert to heavy precipitation where flood warnings are not issued.

The issue here is that Severe Weather Bulletin does not refer to daily accumulated rainfall, which is only possible by Numerical Weather Prediction (NWP). This is why PAGASA introduces NWP for rainfall forecast, which is useful but not yet reliable for heavy rainfall forecast in small areas. PAGASA is requested to provide rainfall forecast up to 3 days ahead by OCD. The preliminary phase of rainfall guidance development was started as an output 2.2 of our technical cooperation project in order to answer to this request.

For observation and short-range (up to three hours) forecast of rainfall in small areas, PAGASA has a plan to install more weather radars under PAGASA modernization plan. The number of radars is going to reach 20 over the entire Philippines archipelago.

*The wave height of 4-14m is indicated from the second stage (maximum sustained speed at 61-100km/h) of PSWS. Wave height 14m seems too high for the second stage tropical cyclones.

1-2 Storm Watch

Storm information is issued when the possibility of thunderstorm is low in the coming 12 hours. Storm watch is issued when the possibility of thunderstorm is high in the coming 12 hours and storm advisory is issued when thunderstorm will occur in specific areas in the coming 2 hours. Storm

watches are issued by each PAGASA Regional Services Divisions. If rainfall surpassing a criteria is expected, heavy precipitation warning is issued in addition to storm watches.

1-3 Meteorological phenomena which cause heavy precipitation

Cumuli cause rainfall and organized cumuli are sustained for long hours and brings about lots of rainfall. Meteorological phenomena which organize cumulus convections are ITCZ, Low Pressure Area, Tropical Depressions, Tropical Storms, Severe Tropical Storms, Typhoons and Super Typhoons. Other phenomena are seasonal monsoons, that is, Habagat from mid June to mid October and Amihan from mid October to mid March.

Strong tropical cyclones are usually associated with heavy rainfall. However, even if tropical cyclone is not strong enough such as a tropical depression or a tropical storm, heavy rainfall is associated and causes serious damages (Tropical Storm Ondoy 2009 and Thelma 1991, Tropical Depression Winnie 2004).

Tropical Storm Thelma which landed on Leyte island in November 1991 was a weak tropical storm with the central mean sea level pressure at 992hPa. The tropical storm brought about heavy precipitation of 580mm in three days around Ormoc city of Leyte island. It caused severe flood and claimed casualties of 8000 persons including missing persons.

Tropical Storm Ondoy caused severe flood in the Metro manila region and claimed casualties around several hundred people.

Habagat is sometimes strengthened due to tropical cyclones which is placed to the northeast of the Philippines, causing intense rainfall and severe flood (Manila Flood, August 2012).

A pamphlet on tropical cyclones, published by PAGASA and JICA in May 2015, floods and landslides are remarked as water related disasters caused by tropical cyclones, which should be paid attention by residents in the affected areas. However, for level 1 tropical cyclone (tropical depression) “no damage to minor damage by wind” is referred, but people may misunderstand that they can escape the severe damage caused by tropical cyclones, such as floods.

In the Philippines, for level 1 (tropical depression) or level 2 (tropical storm) tropical cyclones, residents in the affected region tend not to evacuate although evacuation order is issued. It is heard that a governor once asked a PAGASA manager to raise TCWS to level 3 (severe tropical storm).

JMA also had the same kind of experience and started to use a word “typhoon”, eliminating “weak” from the expression of “weak typhoon”, because weak typhoon sometimes brings about heavy precipitation and cause severe floods and human casualties.

In this regard, severe weather bulletin issued by PGASA should include remarks on the range of

accumulated precipitation for each Region or province in the next 24 hours and its effect on disaster such as floods. Forecasting (daily accumulated) precipitation one day ahead, which can be done only by NWP (Numerical Weather Prediction), is very important and should be given priority from long term perspective.

Because accuracy of rainfall prediction in the tropics is not satisfactory, we need to draw attention of major NWP centers and research organizations to the rainfall prediction in the tropics. In this regard, PAGASA is requested to be a lead center of WMO in the evaluation of rainfall forecast by NWP in the tropics. This should be considered to be a long term activity.

In the Metropolitan area, the criteria for heavy precipitation warning is 30mm/hour and the criteria can be surpassed by a single cumulonimbus or by a small group of cumulonimbi. The criteria for the SLPRSD is 100-120mm/24 hour and the criteria is surpassed by precipitation associated with synoptic disturbances such as tropical cyclones and Tail End of Cold Fronts (TDCF).

The large-scale debris flows at Oshima (2013) and Hiroshima (2014) in Japan were caused by narrow band of multiple cumulonimbi associated with rainfall with a few hundred mm in a few hours. This kind of mesoscale phenomena may be often found in the Philippines if more rain gauge network and weather radars are installed.

Analysis of orographic effect and interactions with synoptic flow such as Habagad on the intensification of precipitation is important and case studies should be performed so that numerical prediction of heavy precipitation is experimented and improved.

1-4 Storm Surge Warning

The storm surge in November 2013 which was caused by Typhoon Haiyan/Yolanda brought attention of the world. Tacloban city was also hit by the same kind of storm surge in 1897 and 1912. In the following chapters, a table of deaths and missing persons since 1980 to 2016 is shown. It was found that storm surges claimed many casualties in the 1980s. In 1984 storm surges caused more than 1150 deaths and missing persons due to two strong typhoons.

Storm surge prediction model provided by Japan Meteorological Agency was installed by PAGASA and started operations in 2016. Color coded storm surge warning signal is being prepared, but not yet authorized within PAGASA.

PAGASA's typhoon chaser team observes height of surge upstream. There are few fixed observation stations for storm surges in the Philippines. JICA donated 19 tide gauges to PHIVOLCS and handover ceremony was conducted in October 2015. PAGASA is advised to have access to the tide gauge data in order to validate their storm surge model and issue storm surge warnings.

1-5 Activities in the target provinces – holding of Consultation Meeting on DRR Collaboration

Consultation meeting on DRR collaboration was conducted in Albay, Sorsogon and Northern Samar provinces. The objective of consultation meeting was to enhance the effectiveness of early warnings on DRR activities. Another objective was to collect disaster records of local floods and rain gauge data obtained by DRRMO of local governments.

At the consultation meetings, representatives from Central Office of PAGASA and SLPRSD, JICA Philippine Office, representatives from DRRMO of local governments gave presentations and exchanged views. There were around 25 to 40 participants.

I gave a presentation on the objective of the technical cooperation project. Dr. Cayanan, Chief of Weather Division gave a presentation on the role of PAGASA in DRRM and on revised Tropical Storm Warning Signal. Officer-in-charge of SLPRSD talked on the recently established heavy precipitation warning. Here we learned that heavy precipitation warning was already prepared through the effort by SLPRSD, although the criteria is targeted to Legazpi city and surrounding municipalities. According to SLPRSD, it was considered provisional.

Representatives from APSEMO, DRRMO from Legazpi City and St. Domingo municipality gave presentations on DRRM activities. The activities included producing hazard maps, training in rescue operations and awareness raising activities toward residents.

The governor of Albay province is committed to DRRM and the director of APSEMO is in his position for more than 20 years since 1994. I found that both of them are a good model to DRRM in other local governments.

In Albay province, evacuation criteria for rainfall amount against floods and debris flow around Mayon volcano are established. Some city and municipalities install rain gauges for that purpose, but they are monitored by barangay people and not connected online. It was learned that the disaster records are archived just for a few years.

This is a reason why it is also important to stress the importance of coordination between PAGASA and local governments. Consultation meetings on DRR collaboration were also held in other provinces.

Because ARG network was installed in the SLPRSD in this technical cooperation project and the observed rainfall data is disseminated to SLPRSD as well as the Central office of PAGASA, heavy rainfall criteria may be extended to other regions of Albay, Sorsogon and Northern Samar provinces. Consultation meeting on elaboration of warning criteria and assessment of operation of warning issuance at SLPRSD was carried out on February 27, 2017. For that purpose, staff from PAGASA central office and forecasters of the SLPRSD gathered in Legazpi city.

1-6 National Disaster Risk Reduction and Mitigation Council (NDRRMC) and DRRMOs of the local governments

The characteristic of DRRM in the Philippines is that it has a permanent organization at all government levels, i.e., national, provincial, city/municipality and barangay levels. When tropical storms affect the Philippines, all DRRMOs and other government agencies coordinate their roles in order to attain the goal of "Zero Casualty" and the president himself appear on TV and calls for evacuation when residents are requested to do so.

The NDRRMC and its secretariat, Office of Civil Defense, archives all kinds of disasters and the information provided by the national government agencies. Most of the early waning information is Severe Weather Bulletins including Public Storm Warning Signals issued by PAGASA.

There is a move to upgrade NDRRMC, which is now presided over by Minister of Philippines National Defense, to be presided by the President and the function expanded. It is not known as of March 2017 whether the reconstruction will be approved or not.

The Table 3-5-1 shows number of deaths and missing persons due to weather related disasters from 1980 to 2016, and supplementary comments which was compiled by National Disaster Coordinating Council (NDCC, an original government council preceding NDRRMC). Because the data was completely lacking for the years 1986-1989, number of casualties was supplemented by the author of this report by Tropical Cyclone Reports, which is compiled and issued annually by PAGASA, as well as by Pacific Tropical Cyclones in Wiki articles. For the number of casualties by storm surges, scientific papers written by PAGASA staff was also referenced. The comments were added to elucidate what kind of disasters were responsible for the major loss of life and missing persons.

The yearly number of casualties differed from each other. Some years did not include casualties due to sea mishaps which was caused by typhoons and bad weather. Although the number of casualties cited by PAGASA's tropical cyclone reports depends on NDCC, the total numbers sometimes do not coincide. The numbers in the table should be considered to indicate trends but not exact numbers.

Since the disaster exceeding 7000 deaths and missing persons due to storm surge by typhoon Yolanda in 2013, the number of deaths and missing persons were 294 in 2014, 176 in 2015 and 54 in 2016. The national goal of attaining "Zero Casualties" may have been very much attained. A United Nations staff concerned with ISDR (International Strategy for Disaster Reduction) commended the engagement of the Philippines regarding DRRM and it is a good example of DRRM to other countries (The Gurdian, Friday 23 October).

Because not many tropical cyclones landed on the Philippines in the year 2015 and 2016 due to El Nino, the climatological factors may have contributed to the lesser number of casualties. The number

of casualties due to landslides are smaller than floods.

In the 1980s to 2008, there were many sea mishaps due to typhoons and bad weather (fogs). In particular, the Princess of the Stars capsized in 2008 due to the strong wind of typhoon Frank, causing 477 deaths, 605 missing persons and 32 saved persons. In the same year a passenger vehicle capsized due to bad weather and over capacity, causing 45 deaths, 30 missing persons and 45 saved persons. Other capsizing of boats happened in 1988, 1996 1998, causing many deaths and missing persons.

After the sea mishaps in 2008, a law was passed which regulates vessels' movement in the seas of the Philippines when TCWS level 1 is issued. The law is interpreted and operated by Philippine Coast Guard and there are no major sea mishaps since then. However, typhoon Nina which landed on Southern Luzon on 24 December 2016 caused18 missing persons and one deaths due to a boat capsizing in the port of Batangas. This is because ship operation is allowed even under TCWS level 1 when the visibility is more than 4km and the boat is taking shelter in a port. This sea mishap may result in a stricter regulation to avoid sea mishaps.

Typhoon Yolanda caused storm surge which claimed many casualties. It is reported that other tropical cyclones hit the same area in 1897 and 1912. From the table below, typhoon Nitang (Ike) landed on Mindanao island in 1984 and caused storm surge which resulted in 490 deaths. The storm surge also claimed 178 deaths on Bohor island. In the same year, another strong typhoon Undang (Agnes) landed on Eastern Samar and caused storm surge and claimed 480 lives in Capiz province on Panay island.

Other storm surges due to strong typhoon also claimed more than 100 lives in 1981, 1983, 1987 and 1995 in the Philippines. PAGASA compiled storm surges since late 19th century in collaboration with USAID. Many of the storm surges may have been high waves because any kind of inundation due to strong wind tends to be classified and reported to NDRRMC as storm in the Philippines.

Improvement of typhoon track forecast and estimation of typhoon strength may have contributed to early evacuation of residents and the lessening of casualties in the decades since 1990s except for the storm surge by Yolanda in 2013. This is a guess and should be confirmed in the future.

The table below shows more than 1000 deaths/missing persons are sometimes caused by torrential rains associated with tropical depressions/tropical storms and strengthening of Habagad. Tropical Depression Winnie which hit Quezon province in 2004 and Tropical Storm Sendong which hit Mindanao in 2011 bought about torrential rains and caused heavy casualties.

Evacuation orders will be followed by residents for strong typhoons, but alerts for tropical depressions and tropical storms, however heavy rain may be associated, may not be taken seriously. This is why Office of Civil Defense (OCD) requests PAGASA to provide them with forecast of rainfall 3-days in advance.

Table 3-5-1 Number of weather related deaths and missing persons (1980 – 2016)

Number of weather related deaths and missing persons, excludes casualties due to pyroclastic flow (based on NDCC/NDRRMC compilation, augmented by annual tropical cyclone report issued by PAGASA and Wiki Pacific tropical cyclone reports)		
year	number of deaths and missing persons : (year) refers to casualties estimated only by Wiki information	
1980	564	
1981	1289	TY Anding (IRMA) 205km/h(905hPa) hit Camarines Sur resulting in 15m storm surge claiming 137 deaths (total deaths 595)
1982	588	
1983	224	TY Vera(Bebeng) 140km/h(965hPa) caused storm surge in Bataan causing 127 dead + 60 missing
1984	2849	TY Nitang(Ike) 150km/h(947hPa) landfall Mindanao on Sep 1, caused storm surges in Surigao del Norte (490dead) and Bohol (178dead). Total number of deaths is 1492. TY Nitang was a precedent to the tropical storm Sendong in 2011 and typhoon Bopha in 2012 which hit Mindanao island and caused massive damage to the island (see below). TY Undang (Agnes) 195km/h(925hPa) landfall south of Borongan, Eastern Samar, on Nov. 4th, caused storm surge in Capiz province (480dead). Total number of dead is 895 + 275 missings. The size of both typhoons, Nitang and Undang, were small and the weather was rather fine before they hit the regions.
1985	647	
1986	(155, 139 dead and 41 missing according to TCR)	
1987	(921, 1259 according tropical cyclone report)	TY Sisang caused storm surge in Matnog, Sorsogon province (287 casualties) In Tropical Cyclone Report 1987, the number of deaths and missing persons due to TY Sisang is reported to be 808 and 171, respectively. The data comes from NDCC. The occurrence of storm surge along the western coast of Sorsogon and heavy damage is mentioned, but its height and the casualties are not mentioned. Minimum sea level pressure in Legazpi was 909.5 and the maximum surface wind observed was 240kph, also in Legazpi. Amount of daily rainfall (8am) was 235.6mm@Catarman and 231.8mm@Masbate.
1988	(606+, according tropical cyclone report 624)	MV Dona Marilyn sank after caught by Typhoon Unsang on October 24, 1988. It caused 389 deaths with 2 missing and 300 survivors. In Tropical Cyclone Report 1988, number of death, missing persons due to typhoon Unsang are reported to be 157 and 60, respectively. No mention on the above mentioned sea mishaps.

1989	(564+)	
1990	993	
1991	5618	TY Thelma caused massive floods called Ormoc tragedy. The number of deaths due to the typhoon was 5109, may reach 8193 including missing persons.
1992	212	
1993	1226	
1994	351	
1995	2040	TY Rosing caused storm surge in Calauag, Quezon province (121 deaths due to storm surge as well as dam failure)
1996	239	ML Gretchen I sank after being battered by strong winds and sank February 18, 1996, causing deaths of 51, unknown missing and 145 survivors.
1997	162	
1998	645	MV Princess of the Orient sank near Fortune island, Batangas, due to typhoon Vicki (Geoding) on September 18, 1998. 70 passengers were killed, 80 missing and 355 survived.
1999	724	
2000	667	
2001	671	
2002	277	
2003	386	
2004	1920	TD Winnie with maximum sustained wind speed at 55km/h 1002hPa approached Quezon province, causing many landslides as well as floodings, killing 1593
2005	193	
2006	3311	Long duration of heavy rain from February 1st to 17th caused massive rockslide-debris avalanch in Southern Leyte resulting in official death toll of 1221. It was not possible to identify the exact number of casualties because they were buried under mud. Total fatality for 2006 may include death toll of this incident. TY Durian (Reming) made landfall on southeastern Catanduanes on November 30th bringing heavy rain up to 457mm total in Albay province, causing lahars around Mt. Mayon with death toll at least 720 with 800-1000 missing. Some report say fatalities at 1500, other report says 2000 dead and hundreds missing. Total damage amounted to 5B PHP.
2007	279	
2008	995	MV Princess of the Stars capsized due to strong winds of typhoon Frank on June 21 2008. 477 persons were dead with 605 missing and 32 saved. Motor banca Jen-Mar capsized on December 14 2008 due to excess passengers and bad weather. It caused 47 deaths, 30 missing and 45 survivors.
2009	1397	TY Ketsana (Ondoy) made landfall on the border of Aurora and Quezon on Sep.

		26 with Tropical Cyclone Warning Signal 2, brought heavy rain to Metro Manila and surrounding regions. Science Garden 454.8mm, Tanay 331.7mm, Manila 258.6mm. This caused massive flooding, landslides reaching 464deaths and 38missing persons, and 6.7B PHP economic damage. TY Parma (Pepen) stayed around the Northern part of the Philippines (Sep 27-Oct 14) causing 465 deaths and 47missing persons, 23B PHP economic damage. Out of deaths, 200 were caused by landslides.
2010	285	
2011	2092	TS Sendong (Washi) made landfall on mid east coast of Mindanao island. Due to excessive rainfall it caused 1268 deaths and 181 missing persons. In the span of 24 hours, 180.9 mm (7.12 in) of rain fell at Lumbia which equates to more than 60 percent of their average December precipitation. Estimates from the Tropical Rainfall Measuring Mission jointly run by NASA and JAXA indicated that accumulations around the Cagayan de Oro river exceeded 400 mm (16 in). Observations from Talakag captured the sheer intensity of rainfall associated with Washi, with hourly accumulations peaking at 60.6 mm (2.39 in). Similar amounts, though less anomalous in magnitude, fell farther east on Mindanao. Satellite estimates indicated accumulations of 200 to 250 mm (7.9 to 9.8 in) along coastal areas near where Washi made landfall. A total of 180.4 mm (7.10 in) was observed in Hinatuan
2012	2360	TY Bopha (Pablo) made landfall at Baganga, Davao Oriental, on Dec. 3 and causing 1067deaths with 834 missing. The total damage was 37B PHP.
2013	7561	More than 7354 due to storm surge caused by storm surge
2014	294	
2015	178	
2016	54	

Table 3-5-2 Major typhoons/tropical depressions after 2000

Rank	Typhoon/Year	Date of Impact	Deaths
1	Haiyan/Yoldanda 2013	November 7-8	6,241
2	Bopha/Pablo 2012	December 2-9	1,901
3	Winnie 2004	November 27-29	1,593
4	Fensheng/Frank 2008	June 20-23	1,410
5	Durian/Reming 2006	November 29 -December 1	1,399
6	Washi/Senelong 2011	December 11-15	1,268 (1079missing)
7	Ketsana/Ondoy 2009	September 25-27	710

	Lingling (Agaton) Ramassun (Glenda) Jangumi (Senian)etc.	2014, whole period	294
	Koppu (Lando) etc.	2015 whole period	52

The number of casualties by typhoon Lando itself was small due to less casualties by floods, however, the percentage of casualties by landslides were around 25% (12 persons). This means that PAGASA may have to issue warnings on landslide in the future, because warnings for landslide needs real time rainfall measurement and forecast and PAGASA is the only government agency that can do it.

1-7 Verification of mean sea level pressure of tropical cyclones

Tokyo Typhoon Center in Japan Meteorological Agency pointed out that the reported mean sea level pressure close to typhoon centers observed at PAGASA stations is sometimes too high compared with the typhoon strength (minimum surface pressure) estimated by Dvorak method using satellite images. The pressure measurements by PAGASA is taken up as a subprogram 1.2 and being discussed in detail.

I used series of synoptic surface maps and compared observed mean sea level pressures around the typhoons and the central surface pressure estimated by Dvorak method. Typhoon Lando landed on Casigran, Aurora province on 18th October 2015. The minimum mean sea level pressure observed at Baler, which is close to Casigran, was 942.5 hPa. The central surface pressure estimated by Dvorak method before Lando landed was 935 hPa. This does not pose any problem.

The eye of typhoon Mario passed close to Masbate city at 12UTC on December 7th 2014. The estimated central mean sea level pressure was 965hPa. However, the minimum synoptic reports at Masbate around the time was 991.7hPa. There are large differences. The typhoon had landed on Samar and Luzon islands before reaching Masbate island and it may have weakened. It must be noted that the estimation by Dvorak method depends on forecasters skill and the value of central mean sea level pressure may be different from actually observed value by as much as 20hPa.

The surface pressure observation at Calapan city on Mindoro, when the eye of typhoon NONA passed close to Calapan on December 14th 2015, was pointed out too high. The instrument and observation environment should be checked by visiting the site in the near future.

JMA uses not only infrared images from geostationary satellite but also rainfall data estimated by microwave channel from polar orbiting satellites on operational basis.

Meteorological Research Institute is also developing a method to estimate the strength of tropical cyclones from wind velocity by Doppler radars. Because PAGASA has a plan to have a network of

20 weather radars, the utilization of Doppler radar data is recommended as a future work.

1-8 Development of QPE/QPF

PAGASA issues heavy precipitation warning using weather radar images that indicates reflective intensity. The images sometimes show interference, sea and ground clutters and other noises. The removal of these noises is being dealt in theme 1.1 of the current technical cooperation project. The theme 2.2 of the project is calibration of radar images by ground based observation of precipitation.

PAGASA has a plan to establish weather radars at 20 sites. PAGASA should aim at producing nationwide radar-rain gauge analysis map and very short range precipitation forecast, although this is a mid-term (3-5 years) object. Soil Wetness Index (SWI) and Runoff Index (ROI) are the next products to be targeted in the long term.

When the Philippines succeed in lessening casualties due to flood, the relative number of casualties due to landslide/debris flow will become noticeable in the future. SWI is the amount of soil water stored in soil and the ranking order is an indicator for the possibility of the occurrence of landslides. In order to compute SWI, we do not need complex geological parameters.

ROI is an indicator of flood occurrence for small basins which is not installed by water level gauges and not covered by flood warning systems.

1-9 Utilization of weather radar data for mesoscale numerical weather prediction

Large scale floods in the Philippines are caused by heavy precipitation events which are associated with tropical cyclones and monsoons such as Habagads and Amihans. It seems that there are no characteristic meso-alfa and meso-beta scale disturbances except cumulonimbi, in and around the Philippines, such as mesoscale disturbances along Baiu fronts that are observed in Japan. The latter disturbances are very difficult to predict by NWP. In order to improve rainfall prediction by NWP over the Philippines, it is important to analyze and write reports how heavy rainfall are brought about by mesoscale disturbances. The mechanism of heavy precipitation should be elucidated in the first place by post event analysis of heavy precipitation events.

Weather radars gives observation data on precipitation and Doppler wind fields. It is possible to use those observation data in data assimilation for NWP. Precipitation data derived by polar orbiting satellites such as GPM project may be useful data for NWP in the tropics. A polar orbiting satellite which measures wind velocity by active laser instruments is going to be launched in 2017. Those data should be accessed, archived and used for post event analysis at PAGASA

1-10 Importance of post analysis after disaster

JMA publishes post-disaster quick meteorological reports when major disasters occur. It is published to show the effectiveness of warnings in DRRM using many pictures and tables. The report describes overall meteorological conditions using surface synoptic maps, satellite images, radar images and surface observations. It also describes the situation of disasters in short and the place and time disasters occurred along with the timing of warnings is issued. It also describes how JMA supported and made correspondence with the national/local/media organizations. It is loaded on the home page of JMA and local meteorological offices so that every DRRM concerned organization and individual citizen have access to it.

PAGASA also issues post-event meteorological report. If PAGASA put more efforts to post-event report and make it available to every DRRM organization and citizen, it will become a good reference of meteorological data related to disasters and public relation material to DRRM organizations and mass media.

1-11 Appointment of senior coordinator for disaster mitigation

In JMA senior coordinators for disaster mitigation are appointed in the headquarters, regional and local meteorological offices. He is responsible for revision of warning criteria, appraisal of effectiveness of warnings and liaison between JMA and national/local government agencies, and other matters related to DRRM. While PAGASA's role in DRRM grows, need for a coordinator for disaster mitigation may increase. Although the assignment of each government agency may differ in the Philippines from Japan, this proposal should be given due consideration.

(2) Results of activities

2-1 Meetings etc.

I visited DRRM offices and schools in the Metro Manila and in Southern Luzon PRSD and made surveys of the situation on DRRM.

Table 3-5-3 Records on main meetings

June 16-18, 2014 First visit to SLPRSD	
June 16	Visit to Virac radar
June 17	Visit to SLPRSD and APSEMO (Albay Province Safety and Emergency Management Organization, DRRMO for Albay province)
June 18	Visit to three elementary schools donated by JICA, which are used for evacuation centers Visit to an AWS (automatic weather station) at Legazpi city fire station.
June 23-25, 2014 Visit to the disaster area caused by typhoon Yolanda	
June 23	Arrival at Tacloban airport and visit to Guiuan RADAR site
June 24	Visit to temporary observation station transferred to DOST Region 8 Office from Tacloban Airport
August 15, 2014 Participation in the PAGASA's Seminar-Workshop for Media in the National Capital Region held in Cavite City	
August 15	Royal Tagaytay Estates, Cavite City
September 1-4, 2014 On site survey on Output3 and Output5	
September 1	Visit to Catarman Weather Office, Northern Samar Province DRRMO and Catarman DRRMO, survey on awareness raising activity at Catarman I Central Elementary School
September 2	Visit to Catarman Municipality hall, Bulan Municipality hall in Sorsogon and Juban Weather office
September 3	Visit to Sorsogon Province DRRMO, meeting with city and 14 Dmunicipality DRRMO staff. Visit to Sorsogon City DRRMO and Gubat Municipality DRRMO
September 4	Visit to APSEMO and OCD-Region V
September 15-17, 2014 DRRMO	
September 16	Participation in the orientation/planning workshop on DRRMO for DEPed Region XI teachers
April 23, 2015	Disaster records were copied at NDRRMC which were not on the NDRRMC home page
July 1-3, 2015	First Consultation Meeting on DRR Collaboration in Albay province. Participants were PAGASA Weather Division Chief, Officer-in-charge of SLPRSD, Representatives from OCD, APSEMO, Legazpi City DRRMO and all the Municipality DRMMOs in Albay province.
August 12-15, 2015	Visited to observation stations at Daet, Pili and Legazpi in SLPRSD in order to check micro barograph with Mr. Matsubara. Visited Guinobatan and Tabaco AWS stations in Albay province
August 17-19, 2015	Consultation Meeting on DRR Collaboration in Northern Samar province and preparatory awareness raising activity in Catarman I Central Elementary School

October 15, 2015	Attendance at handover ceremony of sea level gauges and seismographs from JICA to PHIVOLCS
October 23, 2015	Visited flooded site due to typhoon Lando, Calmpit along Pampanga river)
November 4-7, 2015	Holding of Consultation Meeting on DRR Colaboration, participation in awareness raising activity at Castilla East Central Elementary School and Gubat North Central Elementary School, in Sorsogon province. Visit to radio broadcast station DZRS in Sorsogon city
February 11-12, 2016	Visit to SLPRSD with Mr. Tonouchi, JMBSC, and Mr. Erie, PAGASA staff, to consult with SLPRSD staff on the installment of ARG network
July 28, 2016	Visit to OCD in order to copy weather related disaster records from 2009 to 2016
October 3-6, 2016	Escorted terminal evaluator to SLPRSD, Sosogon province DRRMO, an elementary school and a radio station where awareness raising activities are conducted, Albay province DRRMO, Virac radar site and Manila Airport Meteorological Office for the evaluation of the project.
November 9-10, 2016	Visited with Dr. Cayanan and Mr. Garcia, Officer in Chief of SLPRSD, Sorsogon PDRRMO, Albay PDRRMO and OCD headquarter for Bicol Region in order to find out how the disaster data is archived.
February 3, 2017	Attended a handover ceremony for Giuuan and Aparri radars which was held in PAGASA
February 27-28, 2017	Visited and held a consultation meeting on heavy rainfall warning at SLPRSD, Legazpi with Dr. Cayanan, and three PAGASA staff. A forecaster presented an evaluation of application of the tentative warning criteria to heavy rain events caused by typhoons in 2015 and 20016.

2-2 Trainings and lectures

Lectures on rainfall forecast, which has been developed and operationalized in JMA, were held. Acting administrator Dr. Malano is interested in Numerical Weather Prediction (NWP) and he wanted information on NWP and Data Assimilation, which provides initial conditions for NWP. In this regard, the current status of NWP system and very short range rainfall forecast system was explained. The skill of very short range rainfall forecast and that of rainfall forecast by NWP were compared and the former was far superior to the latter up to three hours forecast. In this comparison, the skills of rainfall more than 30mm per hour were evaluated hourly on 20km mesh grids.

By this lecture, the importance of the objective 2.2, calibration of radar images by ground based rain gauges, or QPE, was pointed out as a basic technology for the issuance of heavy precipitation warnings and flood warnings. On the other hand, it was also pointed out that NWP is very good at

predicting synoptic weather situation up to five days. NWP gives valuable information in predicting the largescale environment which is a background to continuing rainfall.

It was later found that Tropical Cyclone Warning Signal issued by PAGASA does not refer to one day accumulated rainfall amount, which is a key factor to alert the public to floods and landslides. On the occasion of JCCs etc., importance of NWP development was stressed in order for PAGASA to enhance its capacity as a national agency responsible for early warnings. In this regard, training of PAGASA staff in NWP development on long term perspective was proposed.

Table 3-5-4 Main records of lectures

July 18, 2014	First Joint Coordinating Committee (JCC). A lecture "Challenges for PAGASA" was given on topics on establishing warning criteria
Sep. 24, 2014	Special seminar was delivered to PAGASA staff on 1. Numerical weather prediction system, especially, NWP system which predicts mesoscale phenomena of a few to several hundred km horizontal scale. 2. Very short range precipitation forecast
Nov. 21,2014	A lecture on weather, public storm warning signal and heavy precipitation warning entitled "Characteristics of the Weather in the Philippines" was given to JICA volunteers.
Nov. 27, 2014	Second JCC. A lecture on very short range precipitation forecast was given.
July 9, 2015	Third JCC: A lecture was given on the preparation by SLPRSD to issue heavy precipitation warning and the history of warnings by Japan meteorological Agency.
Dec. 22, 2015	A lecture was given to meteorologists in Meteorological Research Institute The title was on the JICA project and the importance of numerical prediction of tropical precipitation which is associated with tropical cyclones. Cooperation on the technical cooperation project was requested.
Jan. 27, 2016	Fourth JCC: Consultation Meetings on DRRM Collaboration were reported. The importance of one-day accumulated rainfall forecast in the severe weather bulletin was stressed as well as the importance of NWP development. PAGASA's contribution to the international NWP community in the form of verification of rainfall forecast in the tropics was recommended.
Mar. 28, 2016	"J-POW special lecture on Global Precipitation Mission and the products" was held toward the staff of PAGASA Weather Division, Hydromet Division and Research, Development and Training Division. The lecturer was from JAXA and supported by JAXA.
Jun. 7, 2016	Fifth JCC: A plan to disseminate rainfall observation data on real time basis to SLRSD as well as the Central office of PAGASA, and to utilize them to issue heavy

	rainfall warnings was announced.
Feb. 17, 20, 24, 2017	Three lectures on Numerical Weather Prediction were given to staff of Weather Division. Each lecture lasted for two hours.
Feb. 28, 2017	Lectures on the "History of weather related hazards in the Philippines and importance of rainfall forecast". This lecture was conducted at SLPRSD to its staff and four participants from PAGASA Central Office including Dr. Cayanan, Chief of Weather Division.
Mar.3, 2017	Attended Philippines Meteorological Society Annual Meeting held at Ministry of Interior and Local Governments. I presented JICA's contribution to PAGASA's Modernization of Meteorological and Hydrological Services, stressing the Japan's continuing contribution started as early as 1973.
April 20, 2017	Special Seminar on Typhoon was conducted. Out of eight presenters, six presenters are from Japanese universities, Meteorological Research Institute/Japan Meteorological Agency and Japanese Space Exploration Agency. Two presenters are from PAGASA Headquarters.

(3) Outcome

The outcome of Output 3 is revised warning criteria in SLPRSD. However, at the start of my work with Output 3, heavy precipitation warning criterion for the Legazpi city and its adjacent municipalities was just established. The criterion was provisional and heavy rainfall advisories was issued for two typhoons, one in 2015 and another in 2016. Numbers of issuance was small because typhoons landed on Sothern Luzon was small due to El Nino. Tentative warning criteria for other province was also proposed. It was found in the course of evaluating heavy precipitation warning that lack of weather related disaster data was the most serious.

Because the cooperation between PAGASA and local governments is prerequisite to the successful implementation of warnings, consultation meeting on DRRM collaboration was conducted in Albay, Northern Samar and Sorsogon provinces. Representatives from provincial and city/municipality DRRMOs as well as PAGASA staff took part in the meeting and exchanged useful information.

By using the rainfall data from ARG network installed by J-POW project, it is now more easy to calibrate radar images from Virac radar against surface based rainfall observation network. This is being done in Output 2.1. If calibrated Radar images are available, it will be used for localized warning criteria as well as issuing warnings.

(4) Collected materials

Weather related disaster records were collected by visiting Office of Civil Defense and provincial

DRRMO (APSEMO). The data also downloaded from NDRRMC homepage was the most detailed disaster records. The records are classified according to the meteorological phenomena with a list of each casualty indicated by the cause of death/injury, the place down to the barangay level. The damage to the infrastructures and agricultural products are also shown in detail.

The staff at SLPRSD is using disaster records from NDRRMC as well as local TV media stored as YouTube. Those records should be shared.

The rainfall data from AWS/ARG has been archived from July 2014, when the project team requested PAGASA to archive. In addition, rainfall data from ARG network in three SLPRSD provinces were also archived. The radar data calibrated by ground based rain gauge data is developed in our project 2.1, and it will be available for issuance of heavy rainfall warning after calibration is completed.

Daily precipitation data at PAGASA SYNOP stations from January 2004 to December 2015 was also collected for the guidance and verification of rainfall forecast by NWP models.

3. 5. 4 Issues to overcome and the points devised in the activities

In order to elaborate and establish heavy rainfall warning criteria, disaster data should be collocated with observation of dense and high quality rainfall data.

The weather radar is the most important observation tool of rainfall, however, radar images are full of noises, that is, ground and sea clutters and electromagnetic interferences. Those noises should be eliminated as soon as possible.

Surface rainfall data from 50+more SYNOP stations in the Philippines are three hourly and they are quality controlled and archived. There are some small numbers of automatic weather stations and automatic rainfall gauges by which rainfall data with every 10 or 15 minutes are obtained.

Those short time interval rainfall data should be quality controlled so that weather radar data be calibrated to produce a radar-raingauge composite map.

We installed ARGs at 9 stations in the provinces of Albay, Sorsogon and Northern Samar as a contribution to PAGASA from J-POW project.

In order to elaborate heavy rainfall warning criteria, disaster data regarding floods and landslides are necessary. Disaster data which caused big damage and human casualties are collected by NDRRMC. However, for the establishment of heavy rainfall warning criteria, local disaster data are also necessary.

Collaboration of PAGASA regional headquarters and local weather observatory with province and city/municipality DRRM Offices are recommended.

PAGASA is requested by NDRRMC to provide it with daily amount of forecast rainfall up to three days ahead. This is because severe weather bulletin refers to maximum hourly rainfall, but not accumulated (daily) rainfall which is closely related to the occurrence of meteorological disasters.

In order to prepare for this, Mr. Taira devised rainfall guidance which used GSM predicted rainfall and trained PAGASA personnel. The product seemed usable for PAGASA forecasters. It should be developed further in the possible follow-on project.

PAGASA has a plan to install a supercomputer with 400 TFLOPS in 2017. In order to further advance its human capacity on the development of Numerical Weather Prediction, intensive training on NWP is necessary. It will be realized by seconding PAGASA personnel to a university in Japan. A PAGASA staff who is qualified for the secondment is ongoing.

3. 5. 5 Achievement situation of the result

For the purpose of elaborating heavy rainfall warning criteria, both fine spatial and temporal resolution rainfall data and local disaster data are necessary. In the Philippines both data are deficient.

The forecasters in the SLPRSD tried to elaborate criteria for each provinces by using three hourly rainfall data at SYNOP stations. It is an understandable endeavor in the Philippines because the situation was almost the same in Japan until 1960s and the warning criteria for heavy rainfall was for the whole prefecture using a daily accumulated rainfall.

Issuance of heavy rain warning just started in June 2012 in the Metro Manila and it will take sometime to establish the criteria. PAGASA's continued effort to establish fine tuned warning criteria for regional services divisions along with the development of observation and forecast of rainfall amount is encouraged.

3. 5. 6 Recommendations for achieving the overall goal

The project consisted of five outcomes, covering from weather observation, forecast, warning, dissemination of information and awareness raising of the public. It was found that PAGASA is good and strong at public relations. The weakest area of PAGASA lies in the handling digital data, including development of Numerical Weather Prediction (NWP), use and development of weather guidance and utilization of weather radar data including QPE and digital satellite data.

The follow-on project should focus on basic technologies of weather observation, development of QPE and satellite data and weather guidance. The staff involved in the development of NWP should be trained on a long term perspective and enrolling PAGASA staff in the graduate course of a Japanese University is the most efficient training.

The enhancement of post-event analysis report, which is a compilation of weather data, weather warnings and records on the PAGASA’s support to OCD and DRRMOs, may be one of the outcome of the follow-on project.

In order to enhance the capacity of PAGASA as a national agency responsible for disaster risk reduction and mitigation, establishment or naming of senior coordinator for disaster mitigation may also be promoted.

3. 6 OUTPUT 4 (Content and accessibility of meteorological information are improved)

3. 6. 1 Project Purpose

(1) Output and indicators should be attained

[Output] 4 Content and accessibility of meteorological information are improved

[Indicators] 4-1 Laymanized and professional information are differentiated at PAGASA website.

4-2 Meteorological information is timely transmitted by PAGASA Central Office (hereinafter called CO) to concerned agencies particularly NDRRMC.

(2) Activities

4-1 Identify challenges on the content of meteorological information.

4-2 Improve the content of meteorological information to be more user-friendly.

4-3 Improve ways of information dissemination to the concerned agencies particularly NDRRMC.

4-4 Improve the content of website at CO and Southern Luzon PRSD (hereinafter called SL PRSD).

3. 6. 2 Issues identified in the baseline survey

According to the baseline survey, the challenges which were identified through interviews with CO, SL PRSD, the concerned agencies and media are as follows:

(1) Meteorological information

Positive indications	PAGASA issues Daily Weather Information as a daily routine and issues the Weather Bulletin when a cyclone is approaching. It shows that PAGASA strives to finely disseminate information.
Challenges	1. The result of the survey conducted by the project team to different agencies shows that PAGASA should issue information that is easy to understand by the general public (Refer Appendix-2). 2. SL PRSD issues the local current weather information only.
Cause and analysis	1. It is true that general public can't understand meteorological technical terms. PAGASA should be aware that they should issue information for both the general public and for technical people and will be understood by the general public. 2. SL PRSD didn’t issue the local forecast.

Counter-measure	[Organizational aspects] 1. PAGASA should improve the contents listed in Appendix-2. 2. SL PRSD should issue the local forecast. [Human resource aspects] J-POW team suggests that PAGASA should think about new apps and meteorological information from public people's point of view.

(2) The ways of information dissemination to the concerned agencies

Positive indications	Meteorological information is timely transmitted by PAGASA CO through the concerned agencies, NDRRMC in particular to public people. To ensure reliable delivery of the information to the concerned agencies, PAGASA uses several transmission channels such as E-mail, FAX, SMS, phone call and so on.
Challenges	There is a delay in transmitting meteorological information when using the SMS by Globe (network provider).
Cause and analysis	When the meteorological information is transmitted to the GLOBE SMS, the messages are sent sequentially one by one to the registered mobile phones. As a result, it will take more time to deliver the message to the subscribers who registered in the system. It takes more than 90 minutes to transmit the information to low priority users after the information was issued. One of the solutions taken was to prioritize the concerned agencies. but that doesn't lead to finding a solution to the root cause of the problem.
Counter-measure	[Technical aspects] A new mobile application was developed to be used in disseminating information from PAGASA to smart phones and tablets (hereinafter called mobile device) users. [Human resource aspects] In the development process, PAGASA acquires the ability to improve the application based on the requirements from the users.

(3) Web site

Positive indications	Lots of weather information is published on the Web site. ICT group is monitoring the Web site for 24 hours and 365days. The Web team often improves the Web site.
Challenges	1. The result of the survey conducted by the project team to different agencies shows that PAGASA should modify the Web site so that it will be easily understood by the general public (Refer Appendix-3).

	2. The user can't get the SL PRSD information for its local key cities forecasts from SL PRSD's Web site. 3. It is difficult for the user who visits the existing Web site of PAGASA for the first time to arrive at the objective Web page. 4. The access time of visiting the existing Web site is slow. 5. PAGASA hasn't done any analysis on the exiting Web site.
Cause and analysis	1. Too much meteorological information posted in the Web site lead to difficulty in designing the Web site layout 2. There is no specific format for the Web site template for all PRSDs 3. Because there is too much information on the existing Web site, the visitors hardly reach his destination. 4. Because all visitors access to the existing Web site, the speed of Web site becomes too slow. 5. Nobody in PAGASA use Google Analytics.
Counter-measure	[Technical aspects] 1. PAGASA should improve the contents listed in Appendix-3. 2. PAGASA should issue the local forecast and update it to SL PRSD's Web site. 3. PAGASA should develop Web site for the mobile device. 4. After developing apps and Web site for mobile device, PAGASA should advertise the new service (apps and website for mobile device). 5. PAGASA should setup Google Analytics in the Web site. [Human resource aspects] Personnel who can use Google Analytics should be assigned.

3. 6. 3 Contents and results of activities

(1) Contents of activities

J-POW project team performed activities which are shown in Table 3-6-1 to solve challenges which are listed in 3.6.2.

Table 3-6-1 Challenges and activities

Items	Challenges	Contents	APPENDIX	OUTPUT
Meteorological information	(1)-1Individual challenges	Requirement (Meteorological information)	2	4-1
		Requirement to improve (APPENDIX-2)	-	4-2

	(1)-2 Issue of local information in SL PRSD	Improvements in SL PRSD (Local information)	9	4-2
The ways of information dissemination to the concerned agencies	(2)-1Development of apps for mobile device (Notification of meteorological information)	Design for apps	4	4-3,4-4
		Trust of the development (mobile device)	5	
Web site	(3)-1 Individual challenges	Requirement (Web site)	3	4-1
		Requirement to improve (APPENDIX-3)	-	4-2
	(3)-2Modification of SL PRSD's Web site	Improvements in SL PRSD (Local information)	9	4-4
	(3)-3Construction of Web site for mobile device	Design for Web site	6	4-4
		Screenshot (for mobile device) FILE Layout	7 8	
	(3)-4Introduce of new service	Spread of new services promotion	12	4-4
	(3)-5Analysis of Web site	Google Analytics' result	10	4-4
		Google Analytics training	11	4-4

Reasons for development of mobile Web site and PAGASA's development of mobile device.

1. Many people visit PAGASA's Web site using their mobile devices but the existing Web site is not mobile friendly.
2. To lessen the traffic to the existing Web site.
3. Helps to reach and satisfy a lot more visitors thereby increasing the awareness about meteorological information.

It is difficult to completely separate the technical and the laymanized information of the site on the Web site. In this project, professionals utilize existing Web site for technical terms, laymanized assumed to utilize the mobile device.

(2) Questionnaire to DRR related organization

In order to confirm that DRR related organizations evaluate weather information provided by South Luzon Province as timely and easy to understand through Output 4 activities, on February 10, 2017, we conducted questionnaires on the city's MDRRMO and the DePed officials in Legaspi City and DRRMO

local offices at Libon City and Camalig City of South Luzon. Totally 30 feedbacks were collected. Contents of the questionnaire are listed in the attached document (APPENDIX - 14).

As shown in Table 3-6-2, 24 people out of 30 people marked "Excellent" or "Good" against the question "Do weather information released by South Luzon Province timely?" It was. In addition, 25 people out of 30 people marked Excellent or Good against the question "Is the weather information released by the South Luzon Province easy to understand? As a result, it is concluded that the achievement goal indicated in the PDM "The assessment that weather information released from PAGASA is timely and easy to understand is 80% or more" was achieved. Tallies by questionnaire items are shown in Table 3-6-6 below.

Table 3-6-2 Summary results of the questionnaire

Q1: What kind of media do you get meteorological information				
Ranking	1st most	second	third	
	TV	Radio	SMS	
Q2: Frequency of the use				
Ranking	1st most	second	third	
	1-7 times/week	1-5 times/day	1-4 times/month	
Q3: What kind of meteorological Information do you use?				
Ranking	1st most	second	third	
	Forecast	Weather bulletin	Warning info.	
Q4: Do you think laymanized meteorological information is timely disseminated?				
Excellent	Good	Fair	Bad	Too Bad
10.0% (3)	70.0% (21)	20.0% (6)	0.0% (0)	0.0% (0)
Q5: Do you thing meteorological information of PAGASA is user-friendly?				
Excellent	Good	Fair	Bad	Too Bad
20% (6)	63.3% (19)	16.7% (5)	0.0% (0)	0.0% (0)

(3) Feedback from the users of Mobile APP

Through the Google Play store, applications for mobile phones are downloaded and used by users on mobile phones. On the other hand, the user can post an evaluation of the application (the user points from "1" to "5", the evaluation is higher as the numerical value is larger) and the review (opinion). When we look at the Google Play store, we can refer not only to the number of downloads of the application but also the evaluation average of users (Figure 3-6-1).

Figure 3-6-1 Google Play Store Evaluation
(Red circle shows the average evaluation from users)

As of March when referring to the Google Play Store, the evaluation average of users for PAGASA's application was 4.0, which is highly evaluated. In addition, the developer (PAGASA) can obtain more detailed information such as individual reviews from users (Fig. 3-6-2). Using this function, we got individual ratings and reviews between June 2016 and February 2017 when PAGASA released the application. Table 3-6-3 shows the evaluation of PAGASA's application and its number.

Table 3-6-3 Evaluation of Mobile APP feed backed to Google Play Store

Evaluation	1	2	3	4	5	Total
Number	77	33	51	107	374	642

In addition, Table 3-6-4 shows the main reviews of those who added "1" and "2" to the evaluation.

Table 3-6-4 Examples of reviews from users giving lower rating

Contents of review
Take a lot of time to download the latest weather forecast...deleted...
It needs lots of work, very slow.
The location is all wrong Im here at ilocos Norte but it says mabila. What the!!!

Useless. Freezes on opening..
Should be able to cache data, UI is also glitchy.
Not updated weather map,,, plzz update ur apps for better ratings and srvse.

For those who gave low ratings ("1" and "2"), there were opinions such as "can not download", "processing speed is slow", "applications do not work well", and "user interface is bad". In addition to the problem of software, there was also pointed out the operational aspect of PAGASA which said "data is not updated".

The application developed this time has received high praise, but PAGASA should continue to investigate these opinions regularly and maintain highly rated apps in the future.

(4) Outcomes

The document names and contents are shown in Table 3-65 below.

Table 3-6-5 Document names and Contents

Documents	Contents
APPINDEX-1	Interviewees List
APPINDEX-2	Requirement (Meteorological information)
APPINDEX-3	Requirement (Web site)
APPINDEX-4	ENHANCEMENT OF PAGASA MOBILE APPLICATION
APPINDEX-5	Trust of the development (apps for mobile device)
APPINDEX-6	Design for Web site
APPINDEX-7	Screenshots (for mobile device)
APPINDEX-8	FILE Layout
APPINDEX-9	Improvements in SL PRSD (Local information)
APPINDEX-10	Google Analytics' result
APPINDEX-11	Summary of the training
APPINDEX-12	Promotion of new service
APPINDEX-13	How to use Apps and Web site for mobile device
APINDEX-14	Questionnaire

3. 6. 4 Issues to overcome and the points devised in the activities

(1) Setting objectives

The approach to achieving the goal and objectives of the practitioners is shown in the flow chart below that PAGASA and the J-POW project team will follow.

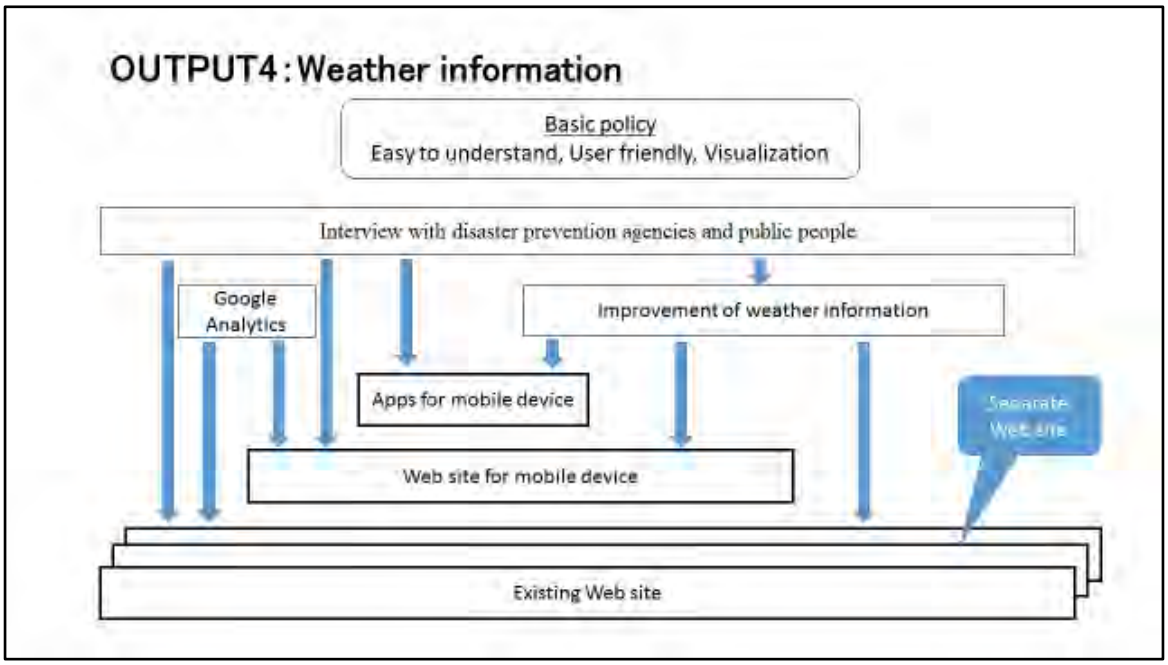


Fig 3-6-2 Activity image the output

(2) Technical Working Group

The technical working group (WG) members were assigned by PAGASA. The activities for this output will be implemented by discussing with WG members. The achievement of the activity will be reported to the officers as required.

Table 3-6-6 WG member (Web site Improvement Group)

Name	Position
Mr. Roberto S. Sawi	WFS, WD
Ms. Samantha Christine V. Monfero	TAMSS, WD
Mr. Raymond C. Ordinario	TAMSS, WD
Mr. Resly George Amador	TAMSS, WD
Ms. Czarina Jane Rosales	TAMSS, WD
Mr. Rene Gumapal	ICT, WFFC
Mr. Michael Bernardo	TAMSS, WD
Ms. Lillian N. Guillermo	SL PRSD

(3) Expected results

Through activities for the output, not only the challenges can be solved but also the following results expected:

3-1 PAGASA will issue user-friendly meteorological information continuously.

3-2 Even under the severe weather condition, PAGASA can reliably transmit meteorological information to the users.

3-3 PAGASA will analyze a Web site and improve the Web site. As a result, PAGASA provide user-friendly information to ordinary people.

3-4 After PAGASA finishes the development of the apps and Web site, PAGASA can transmit forecast and warning information to customers. The customers can read the information and use this information easily.

3-5 PAGASA acquires the ability to improve the application based on the requirements from the users

These results, for the Philippines people, "even when the occurrence of a disaster, such as abnormal weather is a concern, without delay, it is possible to obtain a meaningful meteorological information, the risk of encountering a disaster can be reduced."

(4) Challenges to the operations

In this project the challenges shown in Table 3-6-7 will be solved.

Table 3-6-7 Challenges to the operations

	Challenges to the operations	Device
Meteorological information	The expression is different from PAGASA and JMA. It is difficult for us Japanese to understand. But it may be easy for Philippines to understand.	J-POW team discuss about meteorological information from public people's point of view.
The ways of information dissemination to the concerned agencies	High technology is necessary for apps development	J-POW team decided to develop apps for six months.
Web site	1. Because PAGASA is under the administrative supervision of the DOST, it is necessary for PAGASA's Web Site to follow the format of the DOST's and other ministries' sites. With this,	1. By usage, a user accesses a different server. PAGASA provides service which is independent on DOST to public people (For example

	PAGASA alone cannot solve the Web challenges. 2. The resolution of the mobile device and the device pixel ratio vary by a model and a browser. A model in Philippine is different from in Japan.	apps and Web site for mobile device). 2. The value of the position of an icon and the letter is relative not absolute. The technique of the liquid layout is used.

3. 6. 5 Achievement situation of the result

Achievement situation of the result is shown in Table 3-6-8.

Table 3-6-8 Achievement situation of the result

Output		**Status**	**Remark**
4	Content and accessibility of meteorological information are improved	Completed	Activities 4-1,4-2, 4-3,4-4
Indicators		**Status**	
4-1	Laymanized and professional information are differentiated at PAGASA Web site.	Completed	Activities 4-4
4-2	Meteorological information is timely transmitted by PAGASA CO to concerned agencies particularly NDRRMC.	Completed	Activities 4-3
Activities		**Status**	
4-1	Identify challenges on the content of meteorological information.	Completed	APPENDIX-2,3
4-2	Improve the content of meteorological information to be more user-friendly.	Completed	APPENDIX-2,3,9
4-3	Improve ways of information dissemination to the concerned agencies particularly NDRRMC.	Completed	APPENDIX-4,5
4-4	Improve the content of Web site at CO and SL PRSD.	Completed	APPENDIX-4,5,6,7,8,9, 10,11,12

3. 6. 6 Recommendations for achieving the overall goal

In order for the Overall Goal "Capacity of all PRSDs is enhanced in terms of weather observation, forecasting and warning" to be achieved at higher level, it is important to improve the transmission method and content of weather information by paying attention to the following points.

(1) There is a high possibility that main media of weather information from PAGASA will move from TV to Mobile APP, gradually. Mobile APP is provided only for Android at present. However, to meet the demand from broader users, it is important to develop APP for iPhone, also.

(2) User feedback on Mobile APP (Android) can be obtained through Google Play (Android) or the App Store (iPhone) service. In order to send timely and accurate meteorological information to users, it is important to make use of this advantage and periodically version up the APP based on user needs.

3. 7 Output 5 (Weather Disaster Awareness Raising)

3. 7. 1 Project purpose

(1) Outputs and objectively verifiable indicators

[Output] 5 Activities of awareness-raising on meteorological information are improved at Southern Luzon PRSD.

[Indicator] 5-1 Action plan of awareness-raising is developed.

5-2 Result of the implementation of action plan is reported.

(2) Activities

5-1 Select pilot province(s) for awareness raising activities.

5-2 Assess local situation on the use of meteorological information.

5-3 Analyze causes of weather-related disasters.

5-4 Identify challenges to enhance awareness of local population on weather-related disasters.

5-5 Prepare materials for awareness raising activities.

5-6 Conduct awareness raising activities and collect local feedback on awareness raising activities.

3. 7. 2 Issues identified in the baseline survey

The baseline survey was implemented in pilot areas in order to examine the current status of awareness-raising activities conducted by PAGASA and LGUs. During the first visit in September 2014, surveys were conducted at PAGASA Central Office (CO), SLPRSD, synoptic stations and LGUs, and they focused especially on the current status of their awareness-raising activities and materials. During the second visit in November 2014, surveys were conducted at DepEd groups, elementary schools and radio stations, and they focused especially on the possibilities of their cooperation with the project.

(1) Status of awareness-raising activities

In the pilot provinces, Field Station staff have conducted awareness-raising activities on weather-related disasters. Printed materials produced by PIU (Public Information Unit, PAGASA CO) have been distributed to local people.

The current awareness-raising activities on weather-related disasters are summarized below.

Catarman Synoptic Station, SLPRSD	The CMO (Chief Meteorological Officer) is in charge of awareness-raising activities and conduct lectures which target high school students, college students and teachers, in collaboration with relevant organizations. The lectures include meteorology, climate, observation, disaster prevention, etc. After Typhoon 'Yolanda', interest in the lectures is growing. In case of typhoon approaching, the CMO sometimes appears on a regional radio station program with phone message explaining the status of typhoon and disaster risk reduction information. Even if warning for storm surge has been issued, there is a problem of families leaving one member behind to protect the household. The amount of printed materials is insufficient for all the participants in seminars. Pamphlets are written in English and mostly textual, so some people throw away them at a glance in Barangay. It would be better if they were translated to the local language for their easy reference.
Sorsogon Synoptic Station, SLPRSD	The CMO is in charge of awareness-raising activities and conducts lectures in collaboration with relevant organizations every month. When he delivers lectures to children, he uses presentation file for general public and gives explanations in local language. Due to lack of equipment for presentation in schools, lectures are usually given in the synoptic station. Pamphlets are only written in English and there is a need to produce materials in local language.
PIU, PAGASA CO	PIU develops public awareness-raising materials and conducts numerous campaigns including seminars, workshops and so on, in cooperation with relevant organizations. Recently these activities have mainly been conducted in Metro Manila. In pilot provinces they have not been conducted over 10 years. The activities on storm surge are required in Sorsogon province. Many people misunderstand the meaning of the Warning System, so it is required to hold seminars especially for nationwide media. As for awareness materials, several kinds of pamphlets and posters are made. CDs which contain the awareness material are distributed to participants in campaign. Although printed materials are requested from Field Stations, PIU is unable to distribute them due to lack of funds. Pamphlets and posters are only written in English and Filipino. It is a problem that there are no staff who can translate them into other local languages. There are some awareness audio-visual materials produced by Panahon TV for a project in cooperation with OCD, PAGASA and UNDP.

LGU	Based on RA10121 (Disaster risk reduction and management act of 2010), DRRMO (Disaster Risk Reduction and Management Office) is established at each LGU and their disaster prevention staff have been conducting awareness activities. The contents of these activities are mainly drills and distribution of printed materials for schools and residents. While materials are provided by PHIVOLCS, some of local LGUs created their own flyers in local language in collaboration with relevant organizations. Existing materials are not easy to understand and in the pilot provinces there are fewer LGUs that conduct activities with PAGASA. Effective materials and campaigns on weather-related disasters are required.
DepEd/ Elementary Schools	Elementary schools have been conducting awareness activities in collaboration with local DRRMOs several times a year, and SDRRMTs (School Disaster Risk Reduction Management Teachers) support them. Occasionally, lectures are organized by local DRRMOs in schools along with science classes. However, these activities mainly focus on earthquake and fire drills. Educational activities and materials on weather information for children are insufficient. Easy-to-understand materials which attract children's attention are required. DepEd groups acknowledged the proposal concerning the project activities. They will cooperate when the activities are organized at schools for which they are responsible and provide translation to the local language.
Radio Stations	Although there is no previous experience in broadcasting educational activities on weather-related disasters, public service time is free for broadcasting such contents as weather information.

(2) Capacity assessment

Item	Results
Catarman Synoptic Station, SLPRSD	Catarman Synoptic Station is located in Catarman city in Northern Samar and has a total of 5 staff members including CMO. The CMO is a meteorologist and is in charge of awareness-raising activities. He has enough knowledge of meteorology and has conducted educational activities in cooperation with local media and related organizations. Presentation materials created by CMO are rather technical and there is room for improvement in this respect. He is going to retire at the end of March 2015, so support for the successor is required.

Sorsogon Synoptic Station, SLPRSD	Sorsogon Synoptic Station is located in Sorsogon city in the province of Sorsogon and has a total of 3 staff members including CMO. The CMO is a meteorologist and is in charge of awareness-raising activities. He has enough knowledge of meteorology and experiences in these activities. Responding to the needs of schools and LGUs, he has conducted lectures very actively. Presentation materials created by CMO are rather technical and there is room for improvement in this respect.
SLPRSD	SLPRSD is located in Legazpi City in the province of Albay and has a total of 8 staff members including OIC (Officer in Charge) and 4 meteorologists. Meteorologists are in charge of awareness-raising activities in Albay. They have enough knowledge of meteorology and experiences in these activities. Although current activities are mainly conducted in Albay Province, it is possible for them to support these activities in pilot provinces.
PIU, PAGASA CO	PIU is a unit under the Training and Public Information Section of the Research and Development and Training Division (RDTD), and has a total of 5 staff members including OIC. The OIC has rich experience of more than 30 years and has been involved in various awareness campaigns. She has high motivation and communication skills. In addition, she understands the current issues and has ability to address them and take necessary measures. A designer has participated in training abroad to learn publication layout/design and has been engaged in producing most of printed materials. An illustrator can draw artistic illustrations by hand, however, his drawings are required to be easier to understand.

3. 7. 3 Outline and outcomes of activities

(1) Outline of activities

Further to the above baseline survey, materials for awareness-raising activities were developed and preparation for the activities were conducted from February to November 2015.

In the middle of August 2015, pretest awareness-raising seminars for pupils (Grade5/6) were held in the capital cities of both of pilot provinces and the materials were improved based on local feedback. In the beginning of November 2015, the first series of awareness-raising seminars were held and radio clips were broadcasted in the pilot provinces. And on October 12 and 13, 2016, the 2nd awareness raising seminar is implemented at 2 elementary schools in Legazpi, Southern Luzon PRSD. The theme of the 2nd seminar is "Flood". In addition, FM radio clip will be aired from FM radio station in Legazpi for awareness raising on Flood.

(2) Outcomes of activities

Table 3-7-1 shows lists of the meeting at the 1st and the 2nd baseline inspections. Outcomes of Activities 5.1-5.5 are as follows.

Table 3-7-1 (1) List of meetings and interviews (From August to September 2014)

Date	Venue	Contents
29th Aug.	PIU	Survey on current status of awareness activities. Collection of existing educational materials.
From 1st to 4th Aug.	Pilot Area (1st Survey)	Survey on current status of awareness activities for PAGASA and LGUs in pilot areas mainly.
8th Sep.	RDTD	Explanation of challenges identified in the baseline survey and action plans to solve them.
9th Sep.	PIU	Explanation of challenges identified in the baseline survey and action plans to solve them.

Table 3-7-1 (2) List of meetings and interviews (November 2014)

Date	Venue	Contents
4th Nov.	DepEd CO	Explanation of action plans and survey on possibilities of cooperation with the project.
From 17th to 22nd Nov.	Pilot Area (2nd Survey)	Explanation of action plans to educational institutions and radio stations and survey on possibilities of their cooperation with the project PR2-EN 03-7 5 20160125.docx.
25th Nov.	PIU	Explanation of action plans and survey on environment for developing materials.
28th Nov.	SLPRSD	Explanation of action plans and confirmation of implementation structure.

[Activity 5.1] Select pilot province(s) for awareness raising activities.

The target PRSD was already decided as Southern Luzon PRSD (SLPRSD). The first JCC meeting acknowledged that the J-POW project had to decide the pilot provinces for the awareness-raising activities. Through the discussion between C/Ps and the long-term experts in the project coordinators meeting held in the end of July, the pilot provinces were nominated as Northern Samar province and Sorsogon province. These pilot provinces were approved in the second JCC meeting held in the end of November 2014.

Pilot PRSD: Southern Luzon PRSD

Pilot Provinces: Sorsogon Province and Northern Samar Province

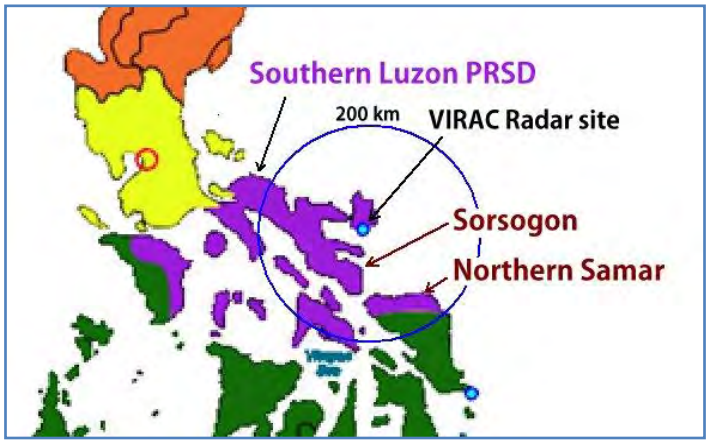


Figure 3-7-1 Location map of pilot province in SLPRSD

[Activity 5.2] Assess local situation on the use of meteorological information.

The consultant team visited the pilot provinces in the SLPRSD area in September and November 2014, and implemented the baseline survey through interviews with the disaster concerned offices.

The weather information issued by PAGASA, such as Weather bulletin, Typhoon information and warning information are disseminated at a national level to a municipal level one by one in DRRMC.

PAGASA weather information is disseminated almost directly, not modified, to municipalities by using many ways, such as FAX, E-mail, SMS, Website, SNS, etc. On the other hand, the information transmitted to the Barangay is not the weather information but the information concerning evacuation.

In Catarman city, the PAGASA station personnel modifies the original weather information with local situation and sends it to PDRRMO, MDRRMO and Radio broadcasting stations. He sometimes visits the radio station and explained the weather events and disaster prevention preparation.

The PAGASA weather information is disseminated to the municipalities through the DRRMC network, but at the municipality level there are some personnel who browse the PAGASA Website. They pointed out that the network speed becomes slow under a bad weather condition.

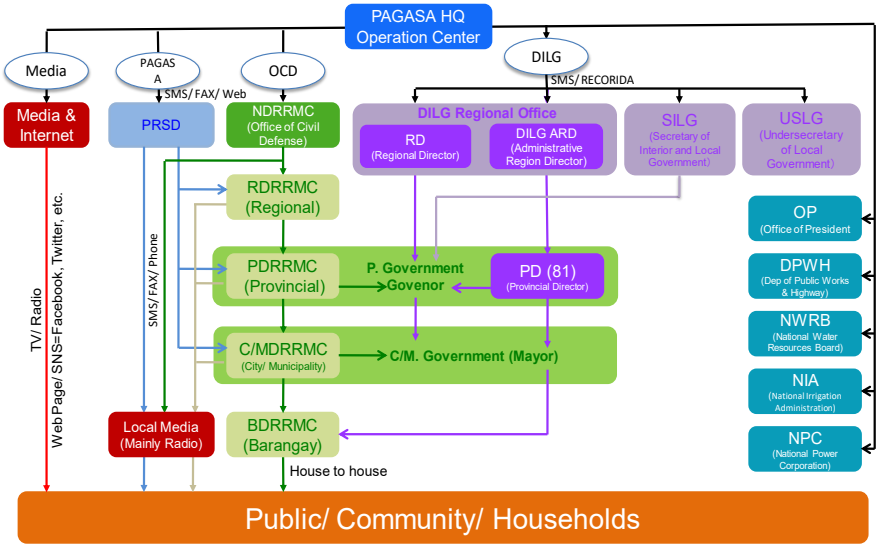


Figure 3-7-2 Dissemination flow of PAGASA information in the DRRMC

[Activity 5.3] Analyze causes of weather-related disasters.

The consultant team visited the pilot provinces in the SLPRSD area in September and November 2014, and implemented the baseline survey through interviews with the disaster-concerned offices, such as Sorsogon PDRRMO and Legazpi OCD), and collected disaster records.

In order to facilitate the analysis of the disaster factors, the time sequence rainfall data is required, but the rainfall data available is only three hourly Synop data, which is not enough to analyze, thus 1-hourly rainfall data, such as AWS data, is required. Since AWS data doesn't have an adequate reliability, the consultant team still needs to continue to collect the AWS data and verify it.

[Activity 5.4] Identify challenges to enhance awareness of local population on weather-related disasters.

The baseline survey on local situation of awareness activities on weather-related disasters in the pilot provinces identified the following issues. The outline of the meetings with C/P is shown in Table 3-7-1.

2-1) Wider social involvement

Positive indication	Field Station staff in pilot provinces have conducted awareness-raising activities in active collaboration with relevant organizations.
Challenges	Activities organized by PIU are mostly project based and are carried out in coordination with other government agencies. In pilot provinces, awareness activities are left to the CMOs of the Field Stations, who have conducted awareness-raising activities as additional work to the main job.

	Existing awareness-raising activities are mainly lectures and seminars, thus these activities tend to attract people who already had strong disaster awareness. Awareness has not been disseminated to the people with less interest and most likely affected. The designer is responsible for development of the printed materials. The technical staff have only opportunities to comment at the final stage of developing the materials. Then, materials are printed after receiving the approval of the executive staff.
Cause and analysis	The number of staff of PIU, who are involved in awareness activities, is insufficient, so additional personnel is required to increase the productivity of the Unit. For reference, in the PHIVOLCS under the DOST, the Geologic Disaster Awareness and Preparedness Division is responsible for awareness activities and has 15 staff members. The Material Development Unit has 5 staff members same as PIU, however, the DRR R&D Unit of the department has geologists and they are engaged in writing printed materials and conducting awareness activities.
Counter-measure	[Organizational aspect] The Training and Public Information Section (TPIS) and PIU support the activities of the Field Stations in such a way as to produce unified teaching materials. In addition, experts should be involved in production process of teaching materials. Promotion of wider activities, collaborating with local communities, such as schools and government, as well as engaging local media should be pursued.

2-2) Provide easy-to-understand information

Positive indication	PIU has technical staff such as designer and illustrator, and is able to produce printed materials on its own.
Challenges	Existing presentation materials for lectures are just enumerated technical information on meteorological disasters such as mechanism, damage situation, countermeasures, etc.; therefore, it would be difficult for the audience to receive the correct awareness message through such lectures. There are insufficient educational materials that are easily understood by children. Some of printed materials do not meet the needs of the local people and are not effectively utilized.
Cause and analysis	The materials should not be just explanation of technical meteorological information, but be awareness-focused materials that will help to raise people's awareness of weather disasters.

	There is insufficient consideration given to the situation of local people and more efforts should be made to prepare easy-to-understand materials. It is necessary to give plenty of consideration to the situation of local people and more efforts should be made to prepare easy-to-understand materials.
Counter-measures	[Organizational aspect] In the process of developing awareness activities and materials for children, C/P will carefully select the topics and messages to be conveyed and review easy-to-understand explanations. [Human resources aspect] To provide easy-to-understand and easy-to-use materials from local people's perspective, it is necessary to learn universal design and usability.

2-3) Lack of material resources

Challenges	Although printed materials are requested from PRSD Field Stations, PIU is unable to distribute them. New original software and equipment for producing materials for awareness-raising activities should be purchased to replace the defective equipment and outdated software. In this regard, TPIS provided the projector and screen when PIU conducted campaign.
Cause and analysis	Budget for producing educational materials is insufficient.
Counter-measure	[Organizational aspect] Budget for printing and equipment to produce materials is required. Increase of the budget for the educational materials is necessary.

2-4) Difference of the word

Challenges	Printed materials such as posters and pamphlets are only printed in English and Filipino. In order to conduct awareness-raising activities for pupils in pilot areas, it is necessary to translate them into local languages. There is no word corresponding to storm Surge in some local languages. It is sometimes confused with other words such as 'Monsoon Surge' which means high tide.
Cause and analysis	Although Filipino and English are the official languages, there are many local languages used in the Philippines. Children are basically raised with their local language and can understand the official language when they finish elementary school.

Counter-measure	[Other aspect] It is necessary to translate essential weather-related terminology to local languages. Whenever possible the words of local language should be used, but, if it is not possible, the English term storm surge should be introduced. This should be done in cooperation with related organizations.

[Activity 5.5] Prepare materials for awareness raising activities.

A set of educational materials which helps pupils to learn weather-related disasters as well as radio clips for the general public have been developed. The main theme is Typhoon with special focus on typhoon-induced storm surge.

Japanese awareness activities and educational materials were introduced to C/P for reference and C/P endorsed the importance of the following:

- "Self-help effort" rather than expertise in meteorological information.
- Further development of cooperation with relevant organizations, especially educational institutions and media for production of materials.

The outline of awareness-raising materials is shown in Table 3-7-2 and the outline of meeting with C/P is shown in Table 3-7-3.

Table 3-7-2 (1) Outline of the 1st Awareness-Raising Materials
(Educational material set for pupils)

Item	Contents	
Objective	Pupils (Grade 5/6)	
Component	1) Presentation Slides	
	Lesson1 : Clouds	- Could formation - Feature/Damage of Cumulonimbus
	Lesson2 : "Bagyo"	- Feature/Damage of Typhoon - Public Storm Warning Signal by PAGASA - Self-help efforts/Mutual-help efforts
	2) Experiment (Cloud formation) - Plastic bottle, Pressure cap	
	3) Small poster - A3 Size - For review after the seminar/class	
Language	English	

Table 3-7-2 (2) Outline of 2nd Awareness-Raising Materials
(Educational material set for pupils)

Item	Contents	
Objective	Pupils (Grade 5/6)	
Component	1) Presentation Slides	
	Lesson 1 : Mechanism of Flood	- Introduction of Flood - What happens when heavy rain occurred? - Mechanism of Flood (3 types)
	Lesson2 : Evacuation from Flood	- Features/Dangers of Floods - How to save your lives from Flood - Self-help efforts/Mutual-help efforts
	2) Practice (Evacuation from Floods) - The Flood Fighter (APP from Google Play and App Store)	
	3) Small poster for distribution to pupil's home - A3 Size - For review after the seminar/class	
Language	English	

Table 3-7-2 (3) Outline of 1st Radio Clips

Item	Contents
Objective	General public
Component	The message giving awareness of self-help effort for the general public who have less interest in disaster risk reduction. 1） Description - Having a correct knowledge will definitely save your life. - Action to protect the household goods from the storm surge is useless, so early evacuation is important. 2) Tag line - Save my life by myself 3) Sound effects - Voice envisaging approach of typhoon or storm surge
Language	Local language ‘Waray’ in Northern Samar province ‘Bikolnon’ in Sorsogon province
Length	Around 30 seconds
Theme	1) Typhoon 2) Storm Surge

Table 3-7-2 (4) Outline of 2nd Radio Clips

Item	Contents
Objective	General public
Component	The message giving awareness of self-help effort for the general public who have less interest in disaster risk reduction. 1） Description - Water flow energy is 800 times stronger than wind energy. - Nobody stop flood. The only and the best way to protect your lives from flood is early evacuation. - Latest information from PAGASA will protect you. 2) Tag line - Save my life by myself 3) Sound effects - Voice envisaging approach of flood
Language	Local language 'Waray' in Northern Samar province 'Bikolnon' in Sorsogon province
Length	Around 30 seconds
Theme	Flood

Table 3-7-3 (1) List of meetings and interviews (February 2015)

Date	Venue	Contents
4th February	PIU	Introduction of awareness materials produced by JMA to the staff of PIU.
From 9th to 10th February	PIU	Group work on development of awareness materials.
12th February	FHIVOLCS GDAP Division	Interview on existing awareness activity and materials. Collection of existing materials.
13th February	PIU	Introduction of awareness materials produced by JMA to the meteorologists of PAGASA Central Office.
From 16th to 24th February	PIU	Group work on development of awareness materials.
23rd February	RDTD	Report on the progress and activity plans to the executive staff.
From 25th to 27th February	Pilot Area	Collection of local feedback on new awareness materials and activity plan from PAGASA SLPRSD, field stations, DepEd and

		elementary schools in SLPRSD. Survey on possibilities of cooperation with the project when the activity is organized in elementary schools.

Table 3-7-3 (2) List of meetings and interviews (May 2015)

Date	Venue	Contents
11th May	PIU	Meeting on activity plan and an increase in the WG membership with an additional meteorologist.
18th May	PIU	Group work on development of awareness materials.
19th May	PIU	Meeting on procurement plan of equipment for awareness activities.
20th May	WD	Group work on development of awareness materials.
22nd May	PIU	Meeting on development plan of awareness materials and work assignment.

Table 3-7-3 (3) List of meetings and interviews (August 2015)

Date	Venue	Contents
6th August	PIU	Meeting on schedule of awareness seminars and work assignment. Group work on development of awareness materials.
7th August	WD	Report on the materials to the executive staff and collection of feedback.
10th August	PIU	Meeting on procurement plan of equipment for awareness activities.
13th August	WD	Group work on development of awareness materials. Final report on the awareness materials to the executive staff.
17th August	WD	Group work on development of awareness materials.
17th August	PIU	Final confirmation on the details of the awareness seminar.
18th August	DYSM Radio Station	Discussion on the production/broadcast of radio clips in Northern Samar province.
20th August	DZMS Radio Station	Discussion on the production/broadcast of radio clips in Sorsogon province.

Table 3-7-3 (4) List of meetings and interviews
(From September to the first half of October 2015)

Date	Venue	Contents
29th September	PIU	Group work on development of awareness materials.
1st October	PIU	Group work on development of awareness materials.
2nd to 6th October	Pilot Area	Collection of local feedback on new awareness materials from PAGASA SLPRSD and field stations. Meeting on arrangement of the venue of 1st Awareness Seminar with local DepEd and elementary schools. Contract with local radio stations for production/broadcast of radio clips.

Table 3-7-3 (5) List of meetings and interviews
(From the second half of October to the November 2015)

Date	Venue	Contents
23rd October	PIU	Group work on development of awareness materials.
26th October	PIU	Group work on development of awareness materials.
27th to 29th October	Pilot Area	Meeting on detailed schedule of 1st awareness seminar with local DepEd and elementary schools.
30th October	PIU	Group work on development of awareness materials.
9th November	PIU	Sharing next activity plans and work assignment especially in the revision for unified materials.

Table 3-7-3 (6) List of meetings and interviews (Late April 2016)

Date	Venue	Contents
15th April	PIU	Future schedule and membership The theme of the 2nd seminar Preparation for the 2nd seminar Regarding the discussion matters with DepEd Region-V Regarding feedback comments at the J-POW meeting
25 th to 26th April	Pirot Area	Discussion with DepEd Region V - proposal of 2nd awareness seminar - regarding nominated schools Discussion at Legazpi Met. Station on the 2nd seminar

Table 3-7-3 (7) List of meetings and interviews (June 2016)

Date	Venue	Contents
2rd June	PIU	Discussion on the contents of seminar materials Discussion on the schedule of the 2nd seminar
8th to 9th June	PIU	Discussion on the contents of seminar materials Confirmation of the scenario of the seminar presentation
13th June	PIU	Confirmation of To Do List Discussion of the schedule and role-sharing

Table 3-7-3 (8) List of meetings and interviews
(From late July to the fast half of August 2016)

Date	Venue	Contents
15rd July	PIU	Group work on development of awareness materials.
27th July	PIU	Group work on development of awareness materials.
1st to 2nd August	Pilot Area	Meeting on detailed schedule of the awareness seminar with local DepEd and elementary schools.

Table 3-7-3 (9) List of meetings and interviews
(From late September to the first half of October 2016)

Date	Venue	Contents
8rd September	PIU	Group work on development of awareness materials.
16th September	PIU	Group work on development of awareness materials.
19th to 20th September	Pilot Area	Meeting on detailed schedule of the awareness seminar with local DepEd and elementary schools.
28h September	PIU	Group work on development of awareness materials.
10th to 13th October	Pilot Area	Second awareness seminar at 2 schools (Oct. 12 and 13) On air of the FM radio clip

Table 3-7-3 (10) List of meetings and interviews
(From late January 2017 to the beginning of February 2017)

Date	Venue	Contents
26th January	PIU	Group work on development of awareness materials. Discussion on the schedule of awareness activities on Feb. 2017
3rd February	PIU	Group work on preparation of goods for awareness activities.

[Activity 5.6] Conduct awareness-raising activities and collect local feedback on awareness-raising activities.

1) Awareness-Raising Seminar for pupils

In August 2015, two pretest awareness seminars were held at elementary schools located in capitals of pilot provinces. In November 2015, the 1st series of awareness seminars were held at four elementary schools located in the pilot provinces. Tables 3-7-4 (1) and (2) show the outline of the seminars.

Followed by the 1st seminar, the 2nd seminar was planned and will implement at 2 schools in the Southern Luzon PRSD, Legazpi Municipality on 12, and 13 Oct. 2016 and 2 schools in the Northern Samar PRSD on February 2017. In the 2nd seminar, feedback information will be collected by questionnaire to the participants and pupils after the seminar (Table 3-7-4 (4)).

For detail information of the presentation of the 1st and the send seminars, please see the Supplementary Materials No. 5-1 to No. 5-4.

Table 3-7-4(1) Outline of Pretest Awareness-Raising Seminars (August 2015)

Date / Time	Participants	Venue
18th Aug. (Tue) 13:00-15:00	**Total 87** Pupils 57 Observers 30	Catarman I Central School, Catarman, Northern Samar Province
20th Aug. (Thu) 8:30-10:30	**Total 97** Pupils 65 Observers 32	Sorsogon Pilot Elementary School Sorsogon, Sorsogon Province

Table 3-7-4(2) Outline of 1st Series of Awareness-Raising Seminars (November 2015)

Date / Time	Participants	Venue
3rd Nov. (Tue) 13:00-15:00	**Total 95** Pupils 45 Observers 50	Urdaneta Central Elementary School Lavezares, Northern Samar Province
4th Nov. (Wed) 9:00-11:00	**Total 80** Pupils 57 Observers 23	Bobon Central Elementary School Bobon, Northern Samar Province
5th Nov. (Thu) 9:00-11:00	**Total 91** Pupils 50 Observers 41	Castilla East Central Elementary School Castilla, Sorsogon Province
6th Nov. (Fri) 9:00-11:00	**Total 93** Pupils 48 Observers 45	Gubat North Central Elementary School Gubat, Sorsogon Province

Table 3-7-4(3) Outline of the 2nd Awareness Raising Seminars (October 2016)

Date / Time	Participants	Venue
12 Oct. (Wed) 13:00-16:00	**Total 160** Pupils 90 Observers 70	Dap-Dap Elementary School Legazpi, Southern Luzon Province
13 Oct. (Thu) 13:00-16:00	**Total 130** Pupils 49 Observers 81	EM's Barrio Elementary School Legazpi, Southern Luzon Province

Table 3-7-4(4) Outline of the 2nd Awareness Raising Seminars (February 2017)

Date / Time	Participants	Venue
7 Feb. (Tue) 13:00-16:00	**Total 116** Pupils 56 Observers 50	Rebong Elementary School Rebong, Northern Samar Province
8 Feb. (Wed) 13:00-16:00	**Total 80** Pupils 70 Observers 10	Catubig Elementary School Catsubig, Northern Samar Province

2) Questionnaire to the participants of the 1st Awareness-raising Seminar

2-1 Questionnaire for the first Awareness-raising Seminar participants

After the 1st awareness-raising seminars, a survey was conducted for observers (teachers, DepEd, Barangay Captain, OCD, etc.) and the evaluation results of the survey questionnaire are presented in Figure 3-7-3.

Almost all the respondents answered “Fully/Extremely” or “Very much” for three items Q1-Q3 related to satisfaction and explanation of lecture. About 97% of respondents answered that they improved their awareness of weather-related disaster risk reduction after the seminar and more than 93% agreed to the concept of this activity aiming at ‘self-protection’ from weather disasters. More than 90% of respondents also evaluated the seminar as “Excellent” or “Good” for materials and many teachers were very eager to relay the lessons to their other classes using these materials.

In the interviews with pupils, they mentioned that they enjoyed an experiment focused on how clouds are formed and learned importance of daily preparedness and early evacuation. Teachers also indicated that pupils were fascinated and actively participated in the seminars, and that these materials are very effective in their science subject.

The aim of this project to make pupils learn entertaining was proved to be effective for enhancing their awareness in weather disaster risk reduction.

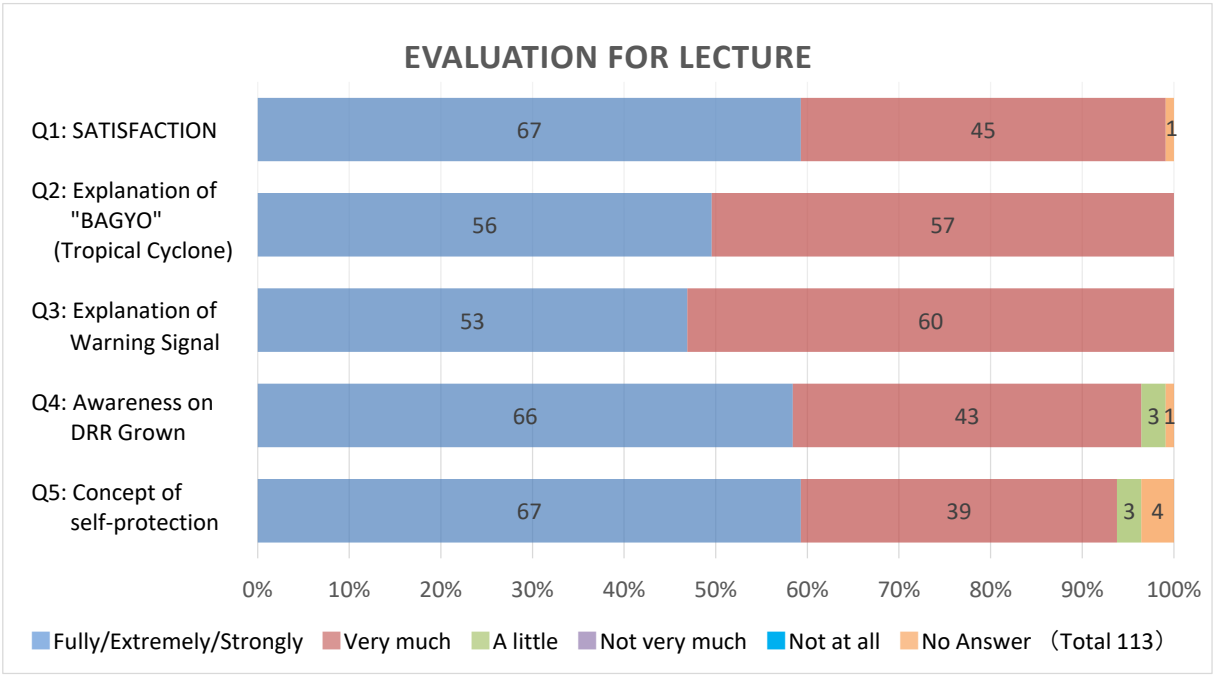


Figure 3-7-3(1) Survey result of the 1st Awareness Seminars (November 2015)
- For Class Content -

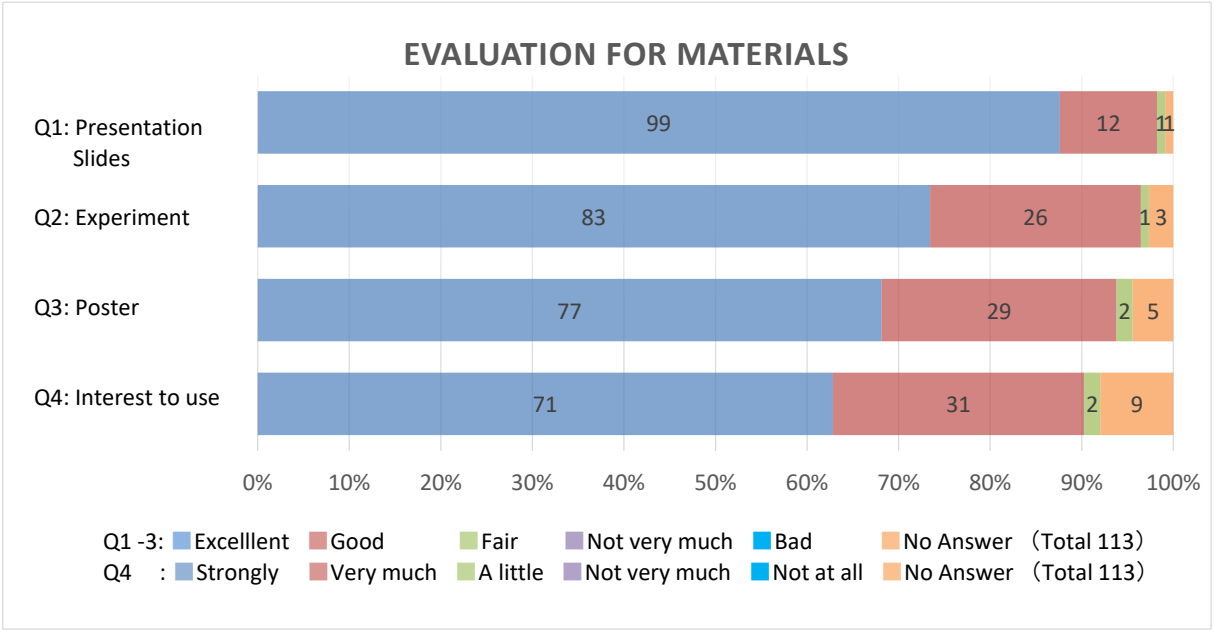


Figure 3-7-3 (2) Survey result of the 1st Awareness Seminars (November 2015)
- For Awareness Materials –

2-2 Questionnaire for the second Awareness-raising Seminar participants

After the 2nd awareness-raising seminars which was held on Oct. 2016 and Feb. 2017, a survey was also conducted for observers (pupils, teachers, DepEd, Barangay Captain, OCD, etc.). Totally 402 of the answer of the questionnaire were collected. The contents of the questionnaire is shown in the Supplementary Materials No.6-6. The results were summarized as follows (Figure 3-7-4).

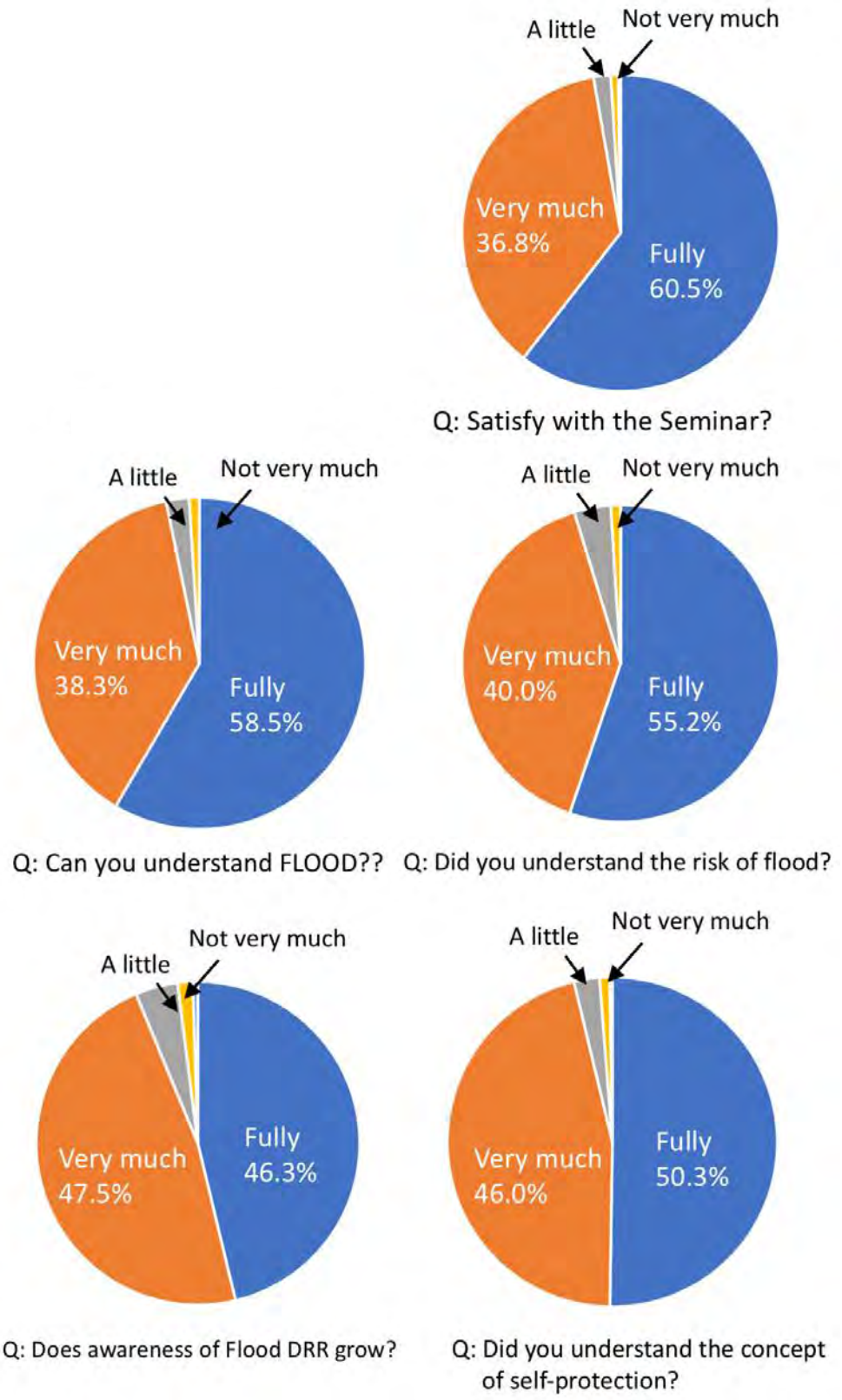


Figure 3-7-4 Survey result of the 2nd Awareness Seminars (Oct. 2016 and Feb. 2017)

3) Broadcast of Radio Clips (November 2015)

Radio clips on “Bagyo” and storm surge were broadcasted in the target areas for a week around the time of the awareness seminars as shown in Table 3-7-5. In order to enhance wider population’s awareness of disaster risk reduction, AM radio stations located in the state capitals of pilot provinces were commissioned production and broadcasting of radio clips. Therefore, broadcast covered almost the entire area of the pilot provinces except for some Islands.

Table 3-7-5 Outline of Broadcast of Radio Clips (November 2015）

Target area	Broadcast date	Broadcast time	Listener	Language	Radio Station
Northern Samar Province	2nd to 8th Nov.	06:40 07:05 08:30 17:20	650,000 (population of the province)	Local language “Waray”	DYSM Radio Station
Sorsogon Province	1st to 7th Nov.	06:00 07:00-7:30 08:00 12:00 16:30-17:30 18:30	500,000 (population of the province)	Local language “Bikolnon”	DZMS Radio Station

Table 3-7-6 Script of Radio Clips (November 2015）

Title	English Message
Bagyo 1	When strong BAGYO is coming, do not panic, rather be prepared for. If you panic, your heart will also panic and stop. You are sure to save your life from BAGYO because PAGASA alert you in advance. Having a correct knowledge will save your life. Keep in mind the tag line, "Save my life by myself" produced by PAGASA & JICA project.
Bagyo 2	When Storm Surge is about to happen, you stay at home to protect the household goods from thieves, don't you? It is useless! Because the Storm Surge will steal all your household goods even your house. Storm Surge is extremely dangerous because big waves rush into the coastal area sweeping like a bulldozer. It is impossible to run away from the rushing Storm Surge. Having a correct knowledge will save your life. Keep in mind the tag line, "Save my life by myself" produced by PAGASA & JICA project.

A total of 41 comments on the radio clips were collected from listeners and classified by age, gender and residence. Figure 3-7-4 indicated that listeners are not biased to the specific region or age so the radio clips were listened widely.

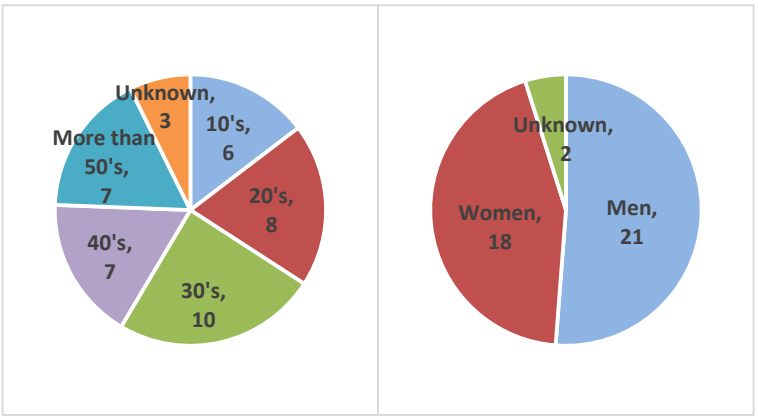


Figure 3-7-4 (1)　Classification of listener who commented (Age, Gender)

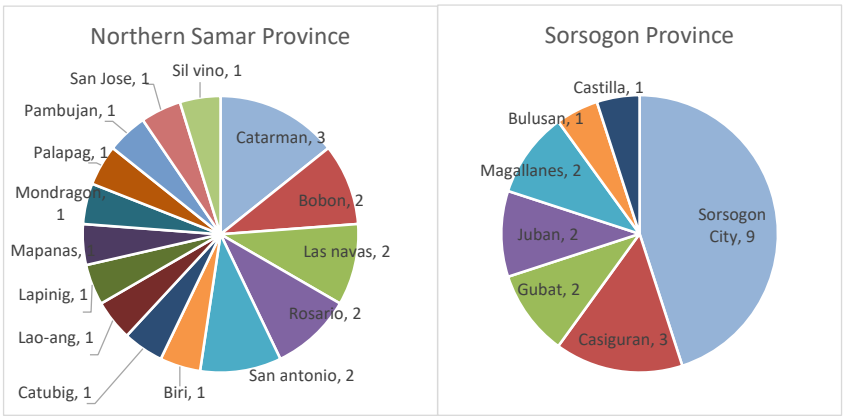


Figure 3-7-4 (2)　Classification of listener who commented (Residence)

The comments including multiple answers were classified into four categories as shown in Figure 3-7-5. Positive evaluation and change in their awareness were reported from about 30% of the listeners, such as:

- Right information is the key to safety. Infomercials such as this help us get to our toes.
- I become aware that food storing or medicines are important during disaster.

About 10% of the listeners also requested for further improvement of its contents as given below:

- We got the message, we need further detailed explanation of storm surge.
- Regular broadcast is requested.

In this respect, the above achieved a good result.

Although comments on their own disaster preparedness activities occupy about 60% of the all,

these awareness-raising activities produced some positive results because the general public was given the opportunity to think about their own weather disaster risk reduction in their daily life. On the other hand, some people couldn't listen to the radio clips because they couldn't get AM signal in the pilot provinces. It is important to provide such information regularly to the general public in collaboration with FM radio stations or other media.

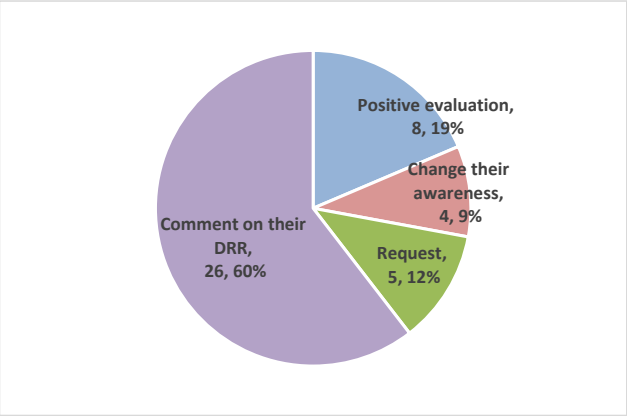


Figure 3-7-5 Comments on Radio Clips from Listeners (November 2015)

Even during the second seminar, the awareness radio clip was broadcasted on the theme of "flood". Broadcasting was conducted from the DWCT - AM station in Legazpi City, southern Luzon Province that conducted a seminar in October 2016. Repeat clips in disaster prevention programs sponsored by DepEd for nearly one month in October It was broadcast. The contents of the clip are shown in Table 3-7-7.

Table 3-7-7 Script of Radio Clips (October 2016)

Title	English Message
Flood	<Sound effect1> Did you know (that) the power of water flow is eight hundred times stronger than the wind? ＜Sound effect2> No one can stop floods. Human beings are powerless before nature. So early evacuation is the only and the best way to protect your life from floods. The latest information from PAGASA will help you. Keep in mind that "Save your lives by yourself" This message is produced by JICA and PAGASA Project on Weather. <Sound effect3>

4) Post Seminar Questionnaire to participants of the 1st Seminar attentants

The theme of the first seminar was "Typhoon". Typhoon NONA landed in the pilot area in December 2015 immediately after the seminar was implemented, and many damage occurred during NONA passing through the area. Based on this situation, we revisited elementary school seminar in the fall of 2016 and carried out a post questionnaire to seminar participants. The purpose of this questionnaire was (1) whether the content of this seminar conducted prior to the typhoon attack was effective for appropriate disaster prevention action from typhoon NONA, and (2) whether disaster prevention knowledge dissemination enlightenment by seminar was useful at the time of occurrence. The contents of the questionnaire is shown in Attachment file 6-6.

Questionnaires from the first seminar were collected at each elementary school during the implementation of the second seminar on Feb. 2017. Since the 6th grade of the elementary school at that time had already graduated, the questionnaires were collected by the 5th grade students at the time of the seminar and observers (totally 144 people). The results were summarized as follows (Fig. 3-7-7).

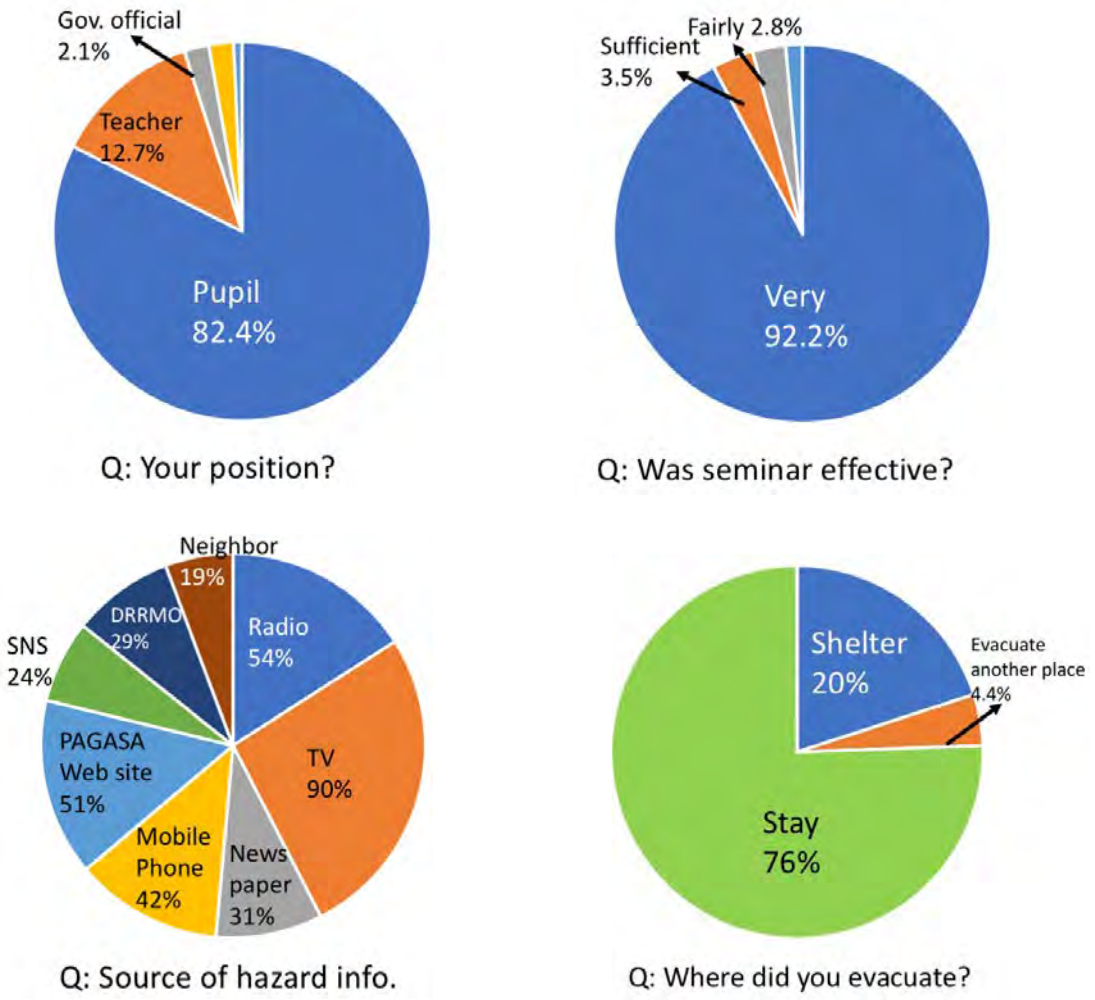


Fig.3-7-7(1) Survey result of the post 1st seminar (1) (Oct. 2016)

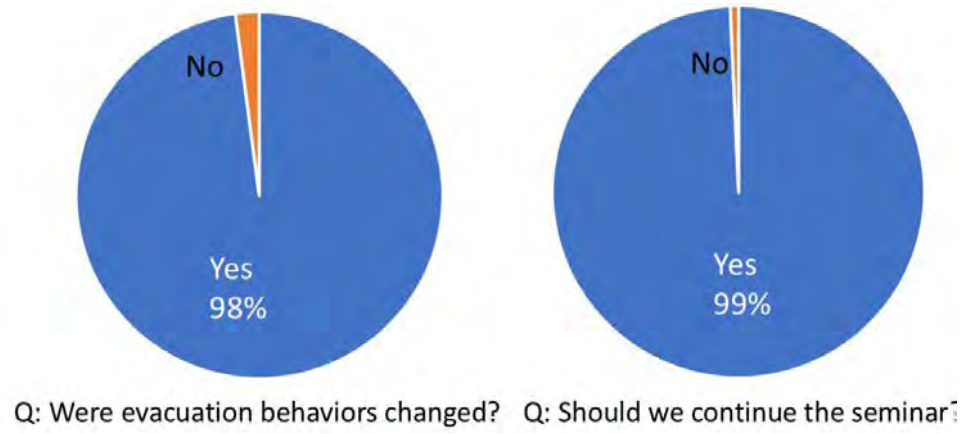


Fig.3-7-7(2) Survey result of the post 1st seminar (2) (Oct. 2016)

According to this, more than 90% of the participants answered the seminar was effective. 98% of the participants answered "yes" as to whether the disaster prevention evacuation behavior changed when an actual typhoon approached, and 99% of the participants answered "yes" as to whether or not to continue the seminar in the future I answered. Based on the above results, it was confirmed that this awareness seminar was effective for the evacuation behavior at the actual typhoon attack.

(3) Outcomes

We are preparing a set of teaching materials consisting of presentation slide, experiment set and enlightenment poster for enlightenment seminar. The summary is shown in Table 3-7-8. The experiment set is a tool to create clouds (clouds of condensed water droplets) in PET bottles. These outcomes were compiled in Annex 5-1 to 5-2.

Table 3-7-8 Awareness materials provided by this project

Title	Contents	Language
Educational materials on Typhoon and Storm Surge for pupils (Grade5/6)	- Presentation slides Lesson 1: Clouds Lesson 2: ”Bagyo” (Tropical Cyclone) - Experimental device (Cloud formation) - Small poster	English
Radio Clips	- Voice file (mp3) Theme1: “Bagyo” (Tropical Cyclone) Theme2: Storm Surge	Local language -‘Waray’ in Northern Samar province -‘Bikolnon’ in Sorsogon province

(4) Collected materials

4-1 Disaster records

Table 3-7-9 Collected materials

Title	Contents	Provider
Risk Analysis	Risk analysis in Sorsogon province (Affected families, population, etc.)	Sorsogon PDRRMO
Incident Monitored	National numeration of disaster (2010 and 2011)	OCD
Incident Monitored	Numeration of disaster in Legazpi city (2013 and 2014)	Legazpi OCD
Most Prominent Hazard based on Schools Affected	National numeration of affected schools disaster by disaster (2009 to 2013)	DepEd
IRIDeS Fact-finding missions to Philippines	Fact-finding report on the Typhoon Yolanda	Tohoku University

4-2 Materials for awareness-raising activities

Table 3-7-10 Awareness materials

Title	Contents	Media	Provider
The Daily Weather Forecast	Mechanism of weather forecast	Pamphlet	PIU
STORM SURGE	Mechanism of Storm Surge	Pamphlet	PIU
FLOODS	Mechanism of Storm Floods	Pamphlet	PIU
Coping with Climate Change	Climate Change and Global Warming	Pamphlet	PIU
THUNDERSTORM	Thunderstorm and disasters associated with it	Pamphlet	PIU
TROPICAL CYCLONE	Tropical Cyclone and disasters associated with it Public storm warning signal	Pamphlet	PIU
PAGASA forecasts and warnings	The PAGASA Weather forecasts and Tropical Cyclone warnings	Pamphlet	PIU
STORM SIGNALS	Public storm warning signal	Poster	PIU
BAHA	Flood associated with typhoon	Poster	PIU
BAGYO	Preparing for typhoon disaster	Poster	PIU
Weather Causing	Lecture on Meteorology	PPT	Catarman

Phenomena Weather and Climate			Station
Hydro-meteorological Hazards & warning system	Lecture on Hydro-meteorological Hazards and warning system	PPT	Sorsogon Station
Weather system affecting The Philippine	Lecture on Meteorology and warning system	PPT	SLPRSD

3. 7. 4 Issues to overcome and the points devised in the activities

(1) Setting objectives

The activity of this output will be implemented as follows.

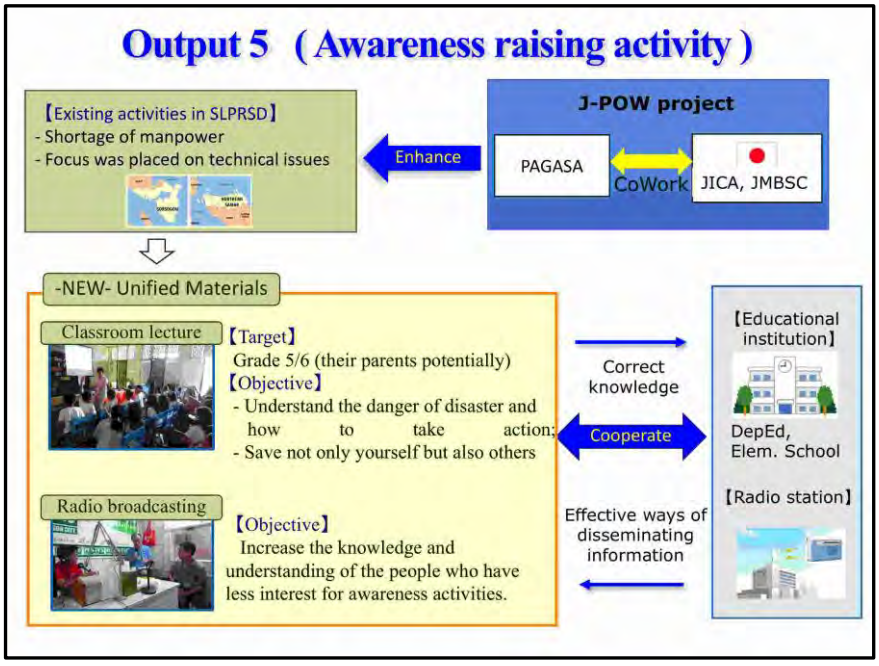


Figure 3-7-6 Activity image of the output

(2) Technical working group

The technical working group (WG) members were assigned by PAGASA. Moreover, a meteorologist of the Weather Division joined the WG in May 2015 in order to conduct awareness seminars.

The activities in this output will be implemented by discussing with WG members. The achievement of the activity will be reported to the officers as needed.

Table 3-7-11　WG member (Public Awareness Group)

Name	Section/Division	Remarks
Ms. Edna T. SEACHON	Senior Weather Specialist, RDTD,WD	
Ms. Venus R. VALDEMORO	OIC, PIU, RDTD	
Mr. Ferdinand CASTILLO	PIU, RDTD	
Ms. Melanie R. AQUINO	Intl. Science Relations Officer I,PIU, RDTD	
Ms. Sharon Juliet M. ARRUEJO	Senior Weather Specialist, RDTD,WD	Joined in May 2015
Ms. Lilian N. GUILLERMO	CMO, SLPRSD	
Mr. Allan ALMOJUELA	SLPRSD	
Mr. Felion C. CORONA	CMO, Catarman Station, SLPRSD	
Mr. Hernando O. PANTOJA Jr.	CMO, Sorsogon Station, SLPRSD	

(3) Expected results

- By creating materials which are easier to understand for pupils, C/P will consider and understand the situation of target people. As a result, existing materials will be improved and become easy-to-understand. Also by using easy-to-understand materials**,** Field Station staff who are not qualified meteorologists can attend seminars as lecturers. It would give them opportunities to enhance their knowledge on meteorology and presentation skills.

- It is expected that providing and sharing materials with teachers and LGUs will promote sustainable activities. Moreover, pupils are expected to share newly acquired knowledge with their parents.

- By developing and implementing awareness activities in cooperation with educational institutions and media, C/P can learn effective ways of disseminating information, and relevant organizations can enhance their knowledge on weather-related disasters.

- We will share the awareness raising materials among DepEd office in the pilot province. It will be quite effective for enhancing awareness activities at schools and municipalities in this region by using shared materials such as presentation slides and posters.

(4) Well-devised point

The following three points are considered so that the awareness activities cannot be mere facade but more effective.

- Awareness of self-help/mutual-help effort
  It is listed as a basic policy to teach the threat of weather disasters and importance of protection by themselves rather than expertise on weather.

- Participatory learning
  Quizzes and experiments are adopted to the lessons to enable pupils to learn while having fun.

- Recommendation on enhanced cooperation with relevant organizations
  Seeking advice from outside, especially educational institutions, is recommended in order to improve awareness materials.

- Implementation of radio clip in local dialogue
  For effective awareness raising for broader ages of residents in target region, we conducted a radio clip by local dialogues.

- Share of the awareness materials among PAGASA local stations and DepEd in the pilot provinces.

3. 7. 5 Achievement situation of the expected results

(1) Indicator 5-1 Action plan of awareness-raising is developed.

Based on the challenges identified in the baseline survey, action plans were developed. Also DepEd groups, elementary schools and radio stations acknowledged that they would support and cooperate on these plans.

After broadcasting radio clips in November 2015, production of video clips was proposed by C/P in the next action plan. The possibility of producing effective video clips should be pursued.

(2) Indicator 5-2 Result of the implementation of action plan is reported.

Based on the action plans given in Section 3.7.3, the materials were developed to improve existing awareness-raising activities in the pilot areas. The 1st awareness seminars for pupils were organized and radio clips for general public were broadcasted.

Thanks to generous support from DepEd in pilot provinces, the seminars have been a success. The staff of DepEd attended the seminar as guests and dozens of teachers in the neighborhood attended the seminar as observers.

The project team appeared on a radio program of DYSM radio station which produced the radio clips in Sorsogon province and the team promoted our activities.

In order to get the feedback from these activities, we have conducted questionnaires and

collected the feedback information, which will be used for the improvement of our awareness seminar.

The 2nd awareness activities are already planned and will be implemented in coming October 2016. The feedback information will be collected the same way as the 1st seminar. These will be also utilized for the improvement of our awareness materials.

In order to conduct these activities continuously, it is essential to build relationships among relevant organizations in the pilot areas. It is a good achievement that a collaboration mechanism has been established through our awareness activities.

(3) Indicator 5-3　Lessons for Overall Goal

In Albay province (not the pilot province) where SLPRSD is located, WG members gave a class in awareness-raising to pupils in October 2015, using new materials developed by this project. The awareness-raising activities have been expanding over the pilot provinces.

PAGASA Central Office is expected to lead awareness-raising activities by preparing unified materials and providing those with the members of other PRSDs. In addition to this, it is also expected that these awareness materials will be widely used for awareness raising practice in the elementary schools not only in the pilot provinces but also in the whole of Philippines by sharing these materials with DepEd. Through these activities, It is expected that awareness-raising activities of all PRSDs will be enhanced in the future.

3. 7. 6　Recommendations for achieving the overall goal

In order for the Overall Goal "Capacity of all PRSDs is enhanced in terms of weather observation, forecasting and warning" to be achieved at higher level, it is important to continue dissemination and awareness activities with the following points in mind.

- Even if the observation capacity and the forecast / warning ability are improved by PAGASA, unless the residents themselves do appropriate actions based on that information, disasters from natural hazard will not be decreased. For that reason, it is desirable that continued awareness raising activities for weather disaster prevention even after the project is over. At that time, cooperation with the region's DepEd is effective.
- In this project, we carried out awareness activities in the pilot district and gave great results, and PAGASA will continue with other initiatives in other provinces so that the disaster prevention base for natural hazards in all provinces in the Philippines will be strengthened

3. 8 Other Activities

3. 8. 1 Outline of the baseline survey

(1) Purpose of the baseline survey

In order to analyze the current status and issues for this project, the baseline survey was implemented under the following terms.

- Maintenance and management status of meteorological equipment
  - 3 Radar sites
  - PAGASA Central Office and SLPRSD observatories (SYNOP/AWS)
- Capacity on forecasting (PAGASA Central Office)
- Weather warning issuance (SLPRSD)
- Meteorological information transmission (PAGASA Central Office and SLPRSD)
- Awareness raising on meteorological information (SLPRSD)

(2) Baseline survey area

The survey areas of the baseline survey were PAGASA Central Office (Metro Manila) and Southern Luzon PRSD.

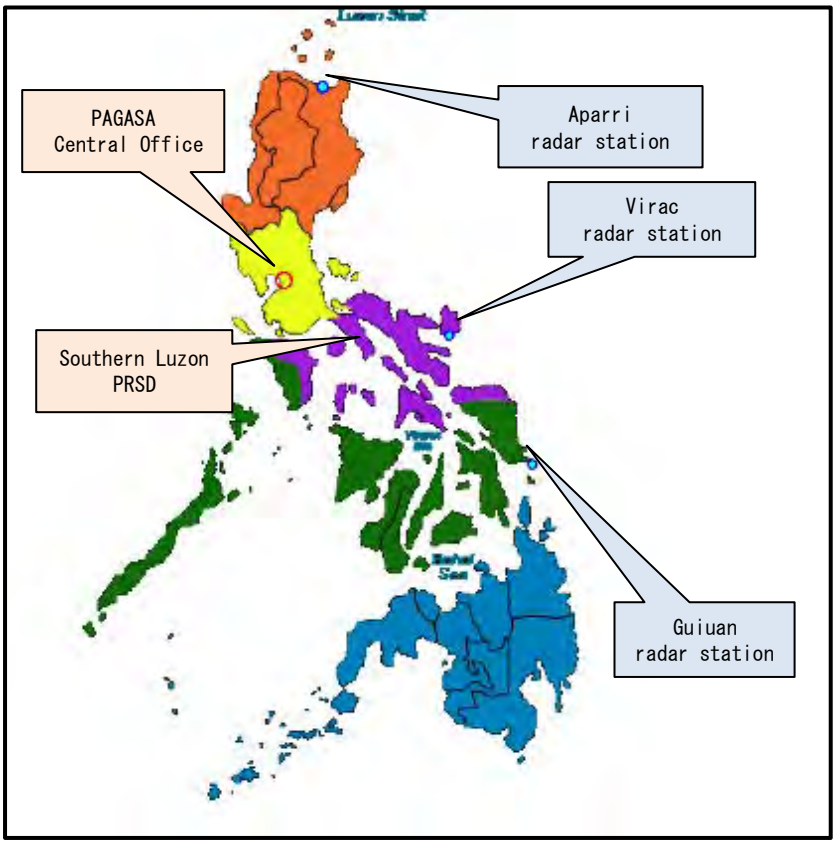


Figure 3-8-1 Location map

(3) Contents and Method of baseline survey

In order to collect information on the basic status of PAGASA and related data, a baseline survey was conducted. The survey was conducted mainly in the form of interview at the relevant sections in PAGASA CO, observatories and local organizations.

The contents of the survey are shown in Table 3-8-1.

Table 3-8-1 Terms and methods of baseline survey

	Target	Terms	Method
[Output 1] Maintenance and management status of meteorological equipment	PAGASA Central Office SLPRSD observatories (SYNOP/AWS) 3 Radar sites	Methods and periodic schedule of maintenance Maintenance manual and procedures Maintenance reports	Maintenance manuals are appropriate for operations. Appropriate maintenance procedures, interval and reports
[Output 1] Capacity on maintenance of equipment and data quality	PAGASA Central Office SLPRSD observatories (SYNOP/AWS) 3 Radar sites	Methods and procedures of maintenance Basic knowledge of staff for observation	Monitor maintenance procedures and knowledge of staff through actual activities Comments on technical knowledge should be recorded.
[Output 2] Capacity on forecasting	PAGASA Central Office	Contents/methods of forecast and manuals Materials and data source for forecast	Comments from PAGASA forecast staff Investigation for forecast procedures
[Output 3] Weather Warning issuance	SLPRSD offices	Issuance process of weather warnings and criteria History of meteorological data and disaster records	Feedback from PAGASA forecast staff Historical data record for improvement of weather warnings
[Output 4] Meteorological information transmission	PAGASA Central Office and SLPRSD	Source, time sequence, communication scheme and users of meteorological information	Comments from PAGASA forecast staff Collection of historical event reports Feedback from users (TV, LGUs and so on)

[Output 5] Awareness raising on meteorological information	SLPRSD	Awareness-raising materials (PAGASA, LGU, TV and local disaster committee)	Awareness-raising activities for meteorological information and its usage Comments from LGU, TV and disaster prevention committee regarding storm surge, typhoon, evacuation, announcement and communication scheme

3. 8. 2 J-POW Meeting

The project team and PAGASA periodically organize meetings to exchange information each other, which is called 'J-POW meeting'. 'J-POW' is a nickname of the project and abbreviation of the project title: "**J**ICA **P**AGASA Project for Enhancing Capacity **o**n **W**eather Observation, Forecasting and Warning".

J-POW coordinator's meetings were held in order to discuss on special topics and issues of concern.

The activities on J-POW are listed in Table 3-8-2.

Table 3-8-2 Activities on J-POW

No.	Date	Contents
1	23 Jul. 2014	Discussion on the issues of concern raised in the 1st JCC meeting
2	5 Aug. 2014	Announcement of the activity plans of expert team at the start of the 1st visit
3	26 Aug. 2014	Announcement of the activity plans of additional experts
4	8 Sep. 2014	Report on the result of the 1st visit
5	21 Oct. 2014	Announcement of the activity plans of expert team at the start of the 2nd visit
6	5 Nov. 2014	Announcement of the activity plan of additional experts
7	14 Nov. 2014	Coordinator's meeting: Discussion on the contents of the 2nd JCC meeting and 1st annual seminar
8	21 Nov. 2014	Coordinator's meeting: Discussion on the contents of the 2nd JCC meeting and 1st annual seminar
9	1 Dec. 2014	Report on the result of the 2nd visit
10	12 Mar. 2015	Activity report on Output 1b, Discussion on Output 2b Progress report
11	12 May 2015	Field activity report on Outputs 2b, 3, and 5, Discussion on PR of J-POW
12	21 May 2015	Report on the 1st field activity report
13	6 July 2015	Discussion on revision of PDM, J-POW PR video, and activity of Output 2b
14	11 Aug. 2015	Field activity report on Outputs 1b, 2b, 4, and 5, Discussion on the schedule

		of Training in Japan and PR activity for J-POW PR.
15	24 Aug. 2015	Field activity reports on Outputs 1b, 2b, 3, 4, and 5. Discussion on PAGASA Handbook.
16	28 Sep. 2015	Discussion on the activity of Output 5 and schedule of JCC
17	7 Oct. 2015	Discussion on the activity of Output 5, DRR collaboration meeting, and the 4th JCC/the annual seminar. Report on J-POW counter-part training.
18	26 Oct. 2015	Field activity reports on Output 1b, 4, and 5.
19	11 Nov. 2015	Reports on the DRR meeting at Solsogon and Output 5 activity. Discussion on the training in Japan and the annual seminar.
20	27 Nov. 2015	Field activity reports on Outputs 1b, 2a, 4, and 1a. Discussion on the logistics of the 4th JCC and annual seminar. Discussion on JICA HQ echo seminar and polo shirt of J-POW project.
21	7 Dev. 2015	Field activity reports on Outputs 1a, 2a and 4. Discussion on the 4th JCC and annual seminar. Confirmation on procurement equipment list.
22	18 Jan. 2016	Activity report on Output 2b, Discussion on the 4th JCC and annual seminar. Announcement of polo shirt of J-POW project, CD of JICA Japan training. Confirmation of the schedule for the present.
23	15 Mar. 2016	Report on Lecture for Radar Staff (15 Feb. - 11 March) Report on Traceability by Short-term experts from JMA (8 to 12 March) Discussion on the 2nd Awareness Seminar (Output5) Report on the Executive summary of progress report
24	13 April 2016	Activity report on Output 4, 5 and ARG work Discussion on the schedule of the 5th JCC (Amihan Hall on 7 June) Reports on the activities of each Outputs.
25	3 June 2016	Report on the PDM version 1 Report on the PCM workshop Discussion on the 2nd awarenes seminar and its contents
26	13 June 2016	Report and discussion on the implementation plan of ARG Report and discussion on the Mobil APP (Output 4) Discussion of the implementation plan of 2nd seminar (Putput5)
27	27 July 2016	Accomplishment report on ARG installation work Report on the visiting plan of 2nd awareness raising seminar (Output5)
28	15 Sep. 2016	Discussion on the plan and schedule of Terminal Evaluation Report on the implementation plan of 2nd awareness seminar (Output5) Report on the operational status of ARG

3. 8. 3 Joint Coordinating Committee

(1) The First JCC Meeting

Date and Time: 18 July 2014 09:00-12:00

Venue: Amihan Conference Room, 2nd floor, Main Office Building, PAGASA Science Garden

Agenda: Presentation

- Introduction
- Challenges of PAGASA
- For Reliable and Friendly Weather Information
- Coordination and Public Relations

Questions and answers

Attendee: JCC members

(2) The Second JCC Meeting

Date and Time: 27 November 2014 09:00-12:00

Venue: SEAMEO INNOTECH, Regional Headquarter, Diliman Quezon City

Agenda: Presentation

- Update of JICA's Program
- Status of J-POW Project
- Presentation of the Revised PDF, PO and C/P List
- Presentation on the Development of QPF

(QPF: Quantitative Precipitation Forecast)

Questions and answers

Attendee: JCC members (ca. 48 persons)

(3) The Third JCC Meeting

Date and Time: 8 July 2015 09:00-12:00

Venue: Amihan Conference Room, Science Garden, PAGASA

Agenda: Presentation

- Update of JICA's Program
- J-POW Project Progress Report
- Presentation of the Revised PDM
- Open Forum

Questions and answers

Attendee: JCC members (ca. 39 persons)

(4) The Fourth JCC Meeting

Date and Time: 28 January 2016 08:30-12:00

Venue: SEAMEO INNOTECH, Regional Headquarter, Diliman Quezon City

Agenda: Presentation

- Highlights and Business Arising from previous JCC
- J-POW Project Progress Reports
- Other Activities: Training held in Japan
- Other Matters

Attendee: JCC members (ca. 47 persons)

(5) The Fifth JCC Meeting

Date and Time: 7 Jun 2016 08:30-12:00

Venue: SEAMEO INNOTECH, Regional Headquarter, Diliman Quezon City

Agenda: Presentation

- Highlights and Business Arising from previous JCC
- J-POW Project Progress Report
- Revision of Counterpart List
- Terminal Evaluation

Attendee: JCC members (ca. 45 persons)

(6) The Sixth JCC Meeting

Date and Time: 18 October 2016 13:00-16:00

Venue: Amihan Conference Room, Science Garden, PAGASA

Agenda: Presentation

- Highlights and Business Arising from previous JCC
- Result of Joint Terminal Evaluation
- Project Progress Report & Discussion from Future Plan of Project
- Other Matters

Attendee: JCC members (ca. 33 persons)

(7) The Seventh JCC Meeting

Date and Time: 21 April 2017 09:00-12:00

Venue: L.B. Soriano Hall, SEAMEO INNOTECH, Commonwealth Ave., Diliman, Quezon City

Agenda: Presentation

- Highlights and Business Arising from previous JCC
- Project Purpose, Goal, and Structure
- Project Accomplishment Reports
- Other Matters

Attendee: JCC members, Meteorological Researchers from Japan as observers (ca. 46 persons)

3. 8. 4 Seminars

(1) The First Annual Seminar

Date and Time: 27 November 2014 13:30-16:30

Venue: SEAMEO INNOTECH, Regional Headquarter, Diliman Quezon City

Theme: Typhoon and storm surge

Agenda: Presentation

・Key Note Lecture

- Disaster Prevention Efforts of JMA on Storm Surge and Heavy Rain by Typhoon -

・PAGASA's Initiatives against Typhoon Disaster

Panel Discussion

・Questions and answers

Attendee: PAGASA, JCC members and general public (ca. 100 persons)

(2) The PAGASA special seminar

Date and Time: 28 November 2014 13:30-16:30

Venue: Training, 2nd floor, Main Office Building, PAGASA Science Garden

Agenda: Presentation

・Development of QPE and QPF in JMA

・SWI and RI for warning issues

QPE: Quantitative Precipitation Estimate

QPF: Quantitative Precipitation Forecast

SWI: Soil Water Index

RI: Runoff Index

Questions and answers

Attendee: PAGASA, J-POW members (ca. 19 persons)

(3) The Second Annual Seminar

Date and Time: 28 January 2016 13:30－16:30

Venue: SEAMEO INNOTECH, Regional Headquarter, Diliman Quezon City

Theme**:** Disaster Risk Reduction

Agenda: Presentation

・Key Note Lecture

- A role of national weather service for DRR- by Dr. T. Toya

・Extreme Weather Events by Dr. E. Cayanan

・Communicating Weather Hazzard by N. Crus

・Preparedness and Early Response in South Luzon by Engr. R. D. Dimaano

Open Forum

Attendee: PAGASA, J-POW members, general public (ca. 81 persons)

(4) Seminar on Tropical Cyclone (Special Seminar)

Date and Time: 20 April 2017　08:30－16:00

Venue: Amihan Conference Room, Science Garden, PAGASA

Theme:　Tropical Cyclone

Agenda:　Presentation

- Doppler rader analysis of intensity and inner-core structure of Typhoon Haiyan (2013) near landfall　by Mr. Udai Shimada
- Doppler radar and aircraft dropsonde observations on the intensity and structure of tropical cyclones in the Philippine Sea　by Dr. Hiroyuki Yamada
- Tropical cyclone influence on long-term variability of Philippine summer monsoon onset　by Hisayuku Kubota
- Typhoon climatology for the Philippines　by Ms. Thelma A. Cinco
- Tropical cyclone-ocean interactions on Typhoon Haiyan (2013) simulated by a coupled atmosphere-wave-ocean model　by Dr. Akiyoshi Wada
- Lesson Learned in Typhoon Chasing　by Dr. Landrico U. Dalida Jr.
- Recent results of the Global Precipitation Measurement (GPM) mission and applications in the Philippines　by Takuji Kubota
- Concept of Asian Small Precipitation Radar Constellation (ASPRC)　by Yusuke Muraki

Open Forum

Attendee: Meteorological Researchers from Japan, PAGASA, J-POW members, general public (ca. 55 persons)

(5) The Third Annual Seminar

Date and Time: 21 April 2017　13:30－16:30

Venue: Pearl Main Hall, SEAMEO INNOTECH, Commonwealth Ave., Diliman, Quezon City

Theme:　Modernization of the Meteorological and Hydrological Services in Philippines

Agenda:　Presentation

- Modernization of Meteorological Services in Japan by Dr. M. Hatori
- Modernization of PAGASA’s Services by Dr. L. Dalida
- Disaster Risk Reduction and Management in the Philippines After Republic Act 10121 by Mr. E. Salonga

Open Forum

Attendee: PAGASA, J-POW members, Meteorological Researchers from Japan, general public (ca. 67 persons)

3. 8. 5 Training in Japan

(1) Outline of the training in Japan

1) Name of the course "Weather Forecasting" J1522010

2) Period of the training 12-24 October 2015

3) Participants 4 as listed below

Table 3-8-3 Participants in the training in Japan

		Section/Division and Position	Task in charge in the J-POW project
	Ms. Samantha Christine V. Monfero	Weather division/ Senior weather specialist	TWG(Technical Working Group) of Weather Guidance
	Mr. Resly George Q. Amador	Weather division/ Weather observer – I	TWG of Weather Guidance
	Mr. Ramjun A. Sajulga	Numerical Modelling section/ Weather specialist – I	TWG of QPE
	Mr. Larry Ger B. Aragon	Numerical Modelling section/ Weather observer – I	TWG of Weather Guidance

(2) Contents of the training

2-1 Objective and Target

The training in Japan was conducted for the counterparts who participate in the activities of the project as part of the capacity building assistance to the PAGASA staff, at the point in time about one and a half years after the project started.

The main objective of the training was to increase participants' understanding of meteorological operations in Japan (especially in the operation of disaster prevention), and to promote smooth enforcement of project activities.

Participants were expected to obtain the following skills and knowledge through the training:

(i) Understanding of the role of National Meteorological Service in Japanese DRR;
(ii) Understanding of the outline of numerical weather prediction model in Japan;
(iii) Understanding of NWP application technique (Weather Guidance), RADAR products (QPE and QPF) and SATAID software of JMA.

The training was composed of: lectures on the operations of meteorological disaster prevention; study tour of related organizations and facilities; and lectures on NWP and practical studies on SATAID software to meet the above-mentioned objective.

2-2 Schedule of training in Japan

			am		pm1	pm2	Staying place
		9:00	10:00 12:00		13:15 15:15	15:30 17:30	
10/12	Mon						JICA Tokyo
10/13	Tue		JICA briefing Program orientation		Lecture on "Outline of the Meteorological Service in Japan"	Lecture on "JMA Operational Numerical Weather Prediction Systems(1)"	JICA Tokyo
10/14	Wed		Lecture on "JMA Operational Numerical Weather Prediction Systems(2)"		Lecture on "Oprational Forecasting of JMA"	Lecture and Demonstration on "Forecast work support system of JMA" （Move to Nagoya）	JICA Chubu (Nagoya)
10/15	Thu		Lecture on "History of Disaster Prevention Effort in Japan"		Study tour to the memorial facilities of historic severe disaster of "Typhoon Ise-Bay (5915)"	（Move to Kyoto）	Kyoto
10/16	Fri		Visit to "Disaster Prevention Research Institute, Kyoto University"; Lecture on their research on "Typhoon Haiyan"; Discussion on the disaster prevention		Study tour to Experiment facilities of "Disaster Prevention Research Institute, Kyoto University"		Kyoto
10/17	Sat		Kyoto morning bus tour			(Move to Tokyo)	JICA Tokyo
10/18	Sun						JICA Tokyo
10/19	Mon		Lecture on "An introduction to the Weather Guidance" (For a person in charge of QPE) Practice on "Radar data processing"		Lecture on "On Observing Systems Operations" Study tour to "Office of Observing Systems Operations"	Lecture on "Data processing and utilization of Radar and rainfall data in Japan (QPE, QPF and so on)"	JICA Tokyo
10/20	Tue		Lecture on "The Weather Guidance used in JMA" (For a person in charge of QPE) Practice on "Radar data processing"		Discussion with experts of JMA "On the development of Weather Guidance" (For a person in charge of QPE) Practice on "Radar data processing"	Lecture and Practice on "Functions of SATAID (Satellite Animation and Interactive Diagnosis)" "How to use SATAID"	JICA Tokyo
10/21	Wed	（Move to Tsukuba Science City）	Sturdy tour to Meteorological Research Institute		Study tour to JMA Aerological Observatory	Study tour to RIC Tsukuba (Move to Tokyo)	JICA Tokyo
10/22	Thu	(Move to Kiyose city, Meteorological Satellite Center)	Lecture on "Outline of the Meteorological Observation by Satellites and its Applications"		Study tour to Meteological Satellite Center and Office of Computer Systems Operations	(Move to Tokyo)	JICA Tokyo
10/23	Fri		Lecture and Practice on SATAID		JICA closing meeting		JICA Tokyo
10/24	Sat		return home				

2-3 Curriculum of training

Table 3-8-4 (12-24, October 2015)

Training type	time	Contents	Trainer	Place
Lecture	2 hours	Outline of the Meteorological Services in Japan	JMA	JMA Headquarters
Lecture	4 hours	JMA Operational Numerical Weather	JMA	JMA

		Prediction Systems (1) & (2)		Headquarters
Lecture/ Study tour Demonstration	4 hours	Operational Forecasting of JMA and Forecast work support system of JMA	JMA	JMA Headquarters
Lecture	1 hour	History of Disaster Prevention Effort in Japan	JMBSC	Nagoya Local Meteorological Observatory
Study tour	1 hour	Study tour of the Nagoya Local Meteorological Observatory	JMBSC/ JMA	Nagoya Local Meteorological Observatory
Study tour	2 hours	Study tour of the memorial facilities of historic severe disaster of "Typhoon Vera (T5915)"	Staff of the facilities	memorial facilities in Nagoya
Lecture	2 hours	Lecture on the research on Typhoon Haiyan/Yolanda Discussion on the disaster prevention	Disaster Prevention Research Institute, Kyoto University	Disaster Prevention Research Institute, Kyoto University
Study tour	2 hours	Study tour of the experiment facilities of the Disaster Prevention Research Institute, Kyoto University	Disaster Prevention Research Institute, Kyoto University	Disaster Prevention Research Institute, Kyoto University
Lecture	4 hours	An introduction to Weather Guidance The Weather Guidance used in JMA	JMA	JMA Headquarters
Discussion	1 hour	Discussion with experts of JMA "On the development of Weather Guidance"	JMBSC/ JMA	JMA Headquarters
Lecture/ Practice	5 hours	(For a person in charge of QPE) Radar data processing	JMBSC	JMBSC
Lecture	1 hour	On Observing Systems Operations	JMBSC	JMA Headquarters
Study tour	1 hour	Study tour of the Office of Observing Systems Operations	JMA	JMA Headquarters
Lecture	2 hours	Data processing and utilization of Radar and rainfall data in Japan (QPE, QPF and so on)	JMBSC	JMBSC
Lecture/ Study tour	1 day	Sturdy tour of: Meteorological Research Institute, JMA Aerological Observatory and	3 Facilities of JMA	3 Facilities of JMA located in Tsukuba

		RIC Tsukuba		Science City
Lecture/ Study tour	1 day	Lecture on "Outline of the Meteorological Observation by Satellites and its Applications" Study tour of Meteological Satellite Center and Office of Computer Systems Operations	JMA Meteorological Satellite Center	JMA Meteorological Satellite Center in Kiyose city
Lecture/ Practice	5 hours	Functions of SATAID (Satellite Animation and Interactive Diagnosis) How to use SATAID	JMBSC	JMBSC

(3) Outcomes of the training

The understanding and knowledge of participants in actual and latest meteorological information/technique of the National Meteorological Service of Japan were greatly increased by the lectures, discussions and practices by the staff of JMA, JMBSC and other lecturers in the training.

The achievements of the targets are presented below:

3-1 Understanding of the role of the National Meteorological Service in Japanese DRR

Participants could learn deeply on the role of NMS in DRR through many lectures and study tours.

A lecture was provided on the Meteorological Services in Japan which includes the explanation of the Meteorological Service Act, lectures and study tours of operational forecast services of JMA, observing system operations and local observatory. In these lectures and study tours, the latest actual operation status of JMA was explained in detail.

3-2 Understanding of the outline of numerical weather prediction model in Japan

Concerning NWP, there were 2 lectures by the specialists/experts of JMA who were in charge of the development of NWP models.

Participants had also a chance to receive the practical study on the visualization and to have active discussions with them within these lectures.

Participants could obtain much knowledge on NWP through these activities.

3-3 Understanding of NWP application technique (Weather Guidance), RADAR products (QPE and QPF) and SATAID software of JMA

Concerning the weather guidance technique, participants received 2 lectures by a specialist of JMA (who was the chief of development team of NWP applications), and had a chance of

discussions about the technical development with members of development team of JMA. The understanding of this technique of the participants was deepened through these activities.

Concerning the radar data processing, all participants received a lecture by the JMBSC staff (who had been engaged in the technical development in this field for a long time). A participant who is in charge of QPE in the project received special practical training for 5 hours, and deepened his understanding of the radar data processing.

Concerning the SATAID software, participants received a practical lecture and practices by a specialist of JMBSC. They had also a chance to attain much knowledge by receiving the lecture and the study tour of the Meteorological Satellite Center.

As mentioned above, this training achieved very effective results in promoting the project.

3. 8. 5 Short Term Expert Training

Training by short term experts recommended by JMA was planned in the implementation plan. For this purpose, adjustment of the logistical matters were conducted with JMA prior to the implementation.

For the short term expert training on radar data analysis, two different training targets are needed that is data QC at observation site and radar data analysis at PAGASA central. For this reason, it is decided that the former lecturer is done by Mr. Wakabayashi (JMA recommended) and the latter is done by Mr. Nagata of JMA.

Since Mr. Wakabayashi is expected to continue to follow up technology transfer at radar site, he was assigned to be a J-POW team member under the approval of JICA after the short term training on radar data analysis.

Table 3-8-5 Dispatch Plan

Field	Contents	Dispatch schedule
Observation (Meteorological Radar)	・Validation and guidance for application to the site of a draft of Radar maintenance and control manual and a draft of radar quality control guidance. ・Guidance and advice for radar maintenance and control at PAGASA Radar site and data quality management. ・Technical instruction at JRC radar sites	9 to 28, Feb. 2015 (Mr. Wakabayashi, JMA recommended)
	Note: Dispatch after completion of Manual and Guideline	

Surface Observation (Traceability, Calibration)	・Information exchange and sharing on calibration of instrument and maintenance inspection system ・Comparison and examination of digital barometer calibration and thermometer calibration practice. ・Information exchange and examination of PAGASA observation practice and traceability.	1-15, March, 2016
	Note: Dispatch after completion of Manual, Guideline and after donated instruments introduced.	
Radar Data Analysis	・Lecture on the efforts and lessens learned about radar data correction at JMA ・Principle of Meteorological radar, QC of radar data, data correction method, and radar products such as QPE, QPF	18-28, Feb., 2015 (Mr. Nagata, JMA)
	Note: Carried out transfer the dispatch of the second time to the local technical guidance of the radar。	
SATAID Technology	・Utilization of HIMAWARI-8 data ・Lecture and lessens on SATAID operation ・Lessens on Dvorakmethod	15-19, Feb., 2016
	Operation of MTSAT-8 was already started and it is used in PAGASA since Dec. 2015	

Training schedules and its outline are shown in the following tables (Table 3-8-6,3-8-7, 3-8-8). As regards the technical training of SATAID, the detail schedule is shown in Table 3-3-2.

Table 3-8-6 Dispatch Plan (Radar)

date	day		RADAR maintenance
			(Mr. Masaru Wakabayashi)
9-Feb	mon		Travel [Kansai to Manila] 13:20 Airport-PAGASA, Courtesy call
10-Feb	Tue	AM	9:00AM J-POW meeting @ AO Conference room
		PM	meeting with RADAR engineer (ICT, Science Garden 4th floor)
11-Feb	Wed	AM	08:00 hotel-Airport (11:15 MNL-12:15 TRO)
		PM	Survey at Aparri 1
12-Feb	Thu	AM	Survey at Aparri 2
		PM	Lecture : RADAR maintenance and quality check
13-Feb	Fri	AM	Survey at Aparri 3
		PM	(12:55 TRO-13:55 MNL) (13:55 Airport-hotel)

14-Feb	Sat		preparation
15-Feb	Sun		preparation
16-Feb	Mon	AM	04:30 hotel-Airport　(06:15 MNL-07:15 VRC)
		PM	Survey at Virac 1
17-Feb	Tue	AM	Survey at Virac 2
		PM	Lecture : RADAR maintenance and quality check
18-Feb	Wed	AM	(08:45 VRC-09:45 MNL) (09:45 Airport-PAGASA)
		PM	Documentation
19-Feb	Thu		Visit to Tagaytay RADAR site (07:15 hotel-TGT-hotel)
20-Feb	Fri	AM	Lecture : RADAR maintenance and quality check
		PM	Support for lecture
21-Feb	Sat		preparation
22-Feb	Sun		preparation
23-Feb	Mon	AM	07:15 hotel-PAGASA, 10:00 PAGASA-Airport
		PM	(12:55 MNL-14:15 TCB) Tacloban to Guiuan
24-Feb	Tue	AM	Survey at Guiuan 1
		PM	Lecture on RADAR maintenance and quality check
25-Feb	Wed	AM	Guiuan to Tacloban
		PM	(16:30 TCB-17:45 MNL)(17:45 Airport-hotel)
26-Feb	Thu	AM	Documentation
		PM	Documentation
27-Feb	Fri	AM	J-POW meeting
		PM	Report for JICA
28-Feb	Sat	AM	10:30 hotel-Airport, Travel [14:35 Manila to Kansai]

Table 3-8-7　Dispatch Plan (Traceability)

date	day	Surface Observation Traceability
		(Mr. Nakashima, Mr. Kawamura, and Mr. Arakaki)
7-Mar	Mon	J-POW Meeting
8-Mar	Tue	Lecture on barometer calibration and thermometer calibration
9-Mar	Wed	Lecture on traceability and CIMO guideline
10-Mar	Thu	Travel to Daet by land (car) - Daet (survey for observation procedure and observatory equipment)

11-Mar	Fri	Travel to Daet by land (car) - Daet (survey for observation procedure and observatory equipment Travel from Daet to Pili by land (car) - Pili (discussion and survey for observation procedure and observatory environment) Travel from Pili to Legaspi by land (car) - Legaspi (survey for observation procedure and observatory environment)
12-Mar	Sat	Legazpi (discussion and survey for observation procedure and observatory environment) Move from Legazpi to Manila

Table 3-8-8 Dispatch Plan (Radar Data Analysis)

date	day		RADAR data usage (Mr. Kazuhiko Nagata)
18-Feb	Wed	AM	Travel [Narita - Manila] 13:30 Airport-hotel
		PM	(a) Meeting in PAGASA
19-Feb	Thu		Visit to Tagaytay RADAR site (07:15 hotel-TGT-hotel)
20-Feb	Fri	AM	Support for lecture
		PM	Lecture : Principles of RADAR 1 /2 hours WD, RD
21-Feb	Sat		preparation
22-Feb	Sun		preparation
23-Feb	Mon	AM	Lecture : Principles of RADAR 2 /2 hours WD, RD
		PM	Lecture : QC of RADAR data 1 /2 hours WD, RD
24-Feb	Tue	AM	Executive Meeting
		PM	Lecture : QPE and QPF 1 /2 hours WD, RD
25-Feb	Wed	AM	Lecture : QC of RADAR data 2 /2 hours WD, RD, WF
		PM	Lecture : Weather Phenomena 2,3 /4 hours WD, RD, WF
26-Feb	Thu	AM	Lecture : QC of RADAR data 2 /2 hours WD, RD, WF (As same as 25th lecture)
		PM	Lecture : Weather Phenomena 2,3 /4 hours WD, RD, WF (As same as 25th lecture)
27-Feb	Fri	AM	Lecture : QPE and QPF 2 /2 hours WD, RD
		PM	Lecture : QPE and QPF31 /2 hours WD, RD
28-Feb	Sat	AM	10:30 hotel-Airport, Travel [14:50 Manila to Narita]

4. Activity Plan

4. 1 Assignment plan of the project team

The Assignment plan of the project is shown in Appendix 3. The baseline survey, the basic training and consultation with the C/Ps were implemented mostly in August and November 2014 as the main activities for the 1st year of the J-POW Project. In consequence, the following assignment period and time frame of the consultant team were adjusted under the guidance of JICA in order to effectively and efficiently implement the technical transfer as well as consultation and coordination with C/P organization:

- To carry out the training on SATAID, radar data correction and weather guidance in February 2015 in order to keep the interval between training rounds short. This would be beneficial for the technical transfer.
- To carry out the training on the maintenance of the radar after February 2015 when a short-term expert recommended by JMA is to be assigned to the J-POW Project.
- To conduct awareness-raising activities in July when the Philippines' disaster prevention month is observed as well as in November which is the season when disaster prevention awareness increases among the local population. On the other hand, consultations with PAGASA for preparation of materials for awareness raising are to be continued.

In the second year, based on the consultation with C/P, the original plan was adjusted to optimize the assignment plan (see Section 2.3) as shown below:

- Based on the baseline inspection, many technical issues on Radar system were found. Considering this situation, the original plan to practice one week of maintenance training at each Radar sites is modified to allocate half a month for preparation of training environment in order to regulate flaws of Radar system before the training. Thus the assignment of Output 1a was changed from 3.00 MM to 4.00 MM (Output 1a)
- Evaluation of forecast accuracy showed that MOS method will not give a required accuracy compared with Karman filter method. For this, MOS method is used for meteorological guidance and the assignment of Output 2b was changed from 3.00 MM to 6.00 MM (Output 2b).
- In making awareness-raising activities at the pilot areas, support from department of education (DepEd) is necessary for making these activities at elementary schools. For this, the assignment of Output 5b was changed from 4.50 MM to 5.50 MM (Output 5b).
- Based on the baseline investigation, the main focus of meteorological information (Output 4) shifted from revision of Website to consultation and advice for the improvement of meteorological information using SNS and so on. For this reason, the assignment of Output 4 is changed from 12.83 MM to 9.83 MM (Output 4).
- It is considered that collaboration with Output 5 group is very effective for briefing of awareness raising at the sites, because awareness seminar at the pilot areas has been done in collaboration with Output 5 group. From this, the assignment of Output 5 is reduced from 12.00 MM to 10.00

MM (Output 5).

- The project officer of Radar operation and maintenance for the work of baseline inspection and operation manual was assigned to Mr. Hiroshi Yamaguchi. For future technical guidance at Radar sites, Mr. Masaru Wakabayashi, who has a lot of experience in technical guidance and training on Radar maintenance at Cambodia and so on, was assigned in place of Mr. Yamaguchi (31 July 2015).

In the third year, based on the discussion and adjustment with the counterpart, the original plan was adjusted to optimize the project implementation plan listed in Chapter 2. The main contents are as follows.

- For enhancing forecast and warning information capacity using Radar information, construction of ARG network system was implemented at the target provinces. The installation was finished on July 2016 (25 March 2016).
- Due to health issue of Ms. Shizuko Komatsu (Rating Grade-4), she cannot be no longer able to continue the assigned task. For this reason, the assign of Ms. Komatsu is replaced to Ms. Ikuko Inoue, Rating Grade-4 (31 August 2016).
- Due to a requirement from the other JICA program at Dubai, Dr. Masao Mikami, sub Project Manager, is to stay Dubai for invited presentation at the workshop of the other JICA project in Dubai from 25 to 27 Sep. 2016. For attending this workshop, the business trip schedule in Philippines, Sep. 8 to Oct. 19 2016, was adjusted (31 August 2016).
- At the 7th JCC held on April 21, it is necessary to obtain approval from PAGASA for the product of this project, the deadline for submitting the project completion report from April 21 to May 31 (17 April 2017).

4. 2 Assignment plan of the short-term experts

The J-POW Project had prior coordination with JMA with regard to not only the technical training in Japan but also the assignment plan of the short-term experts recommended by JMA.

Although the initial dispatch plan of the short-term experts was (1) Feb. 2015 for surface observation (Radar), (2) Feb. 2016 for surface SYNOP observation (maintenance of meteorological instrument), (3) 2 times including Feb. 2015 for Radar data analysis, and (4) 2 times including April 2016 for usage of SATAID, based on coordination with related departments of JMA, assignment plan was adjusted as follows:

Table 4-2-1 Assignment plan of the short-term experts

Field of Expertise	Activities	Assignment Period
Surface Observation (Radar)	- Evaluation of a draft of the 'Manual on the maintenance and management of the new radar' and a draft of the 'Guidelines on the radar data quality control'. Assessment of the applicability of these documents to local conditions. - Guidance and advice on RAGASA's radar maintenance and management and data quality control - Technical assistance at JRC radar site	Around February 2015
	Note: After developing the manual and guideline, the assignment would be implemented.	
Surface SYNOP Observation (Traceability, Accuracy of Observation)	・Information exchange and technology sharing of meteorological instruments calibration and maintenance system. ・Comparison and inspection on calibration method of the digital barometer and thermometer. ・Information exchange and technology sharing of operational observation and traceability of meteorological instruments.	<u>Around March 2016</u>
	Note: After developing the manual and guideline and installing equipment, the assignment would be implemented.	
Radar Data Analysis	- Lectures on practices for the radar data correction in JMA, lessons learned and so on - Guidance and advice on radar observation services of PAGASA - Lectures and technical guidance on the technique of rainfall depth analysis	<u>1: Around February 2015</u> 2: Future consideration
	Note: After radar data is archived for about one year, the second assignment will be implemented.	

Usage of SATAID	・Utilization of HIMAWARI 8 data ・Lecture and training of operation of SATAID ・Lecture of Dvorak method	1: Around February 2015 2: Future consideration
	Note: The operation of newly launched HIMAWARI 8 (MTSAT-8) was started from July 2015 and it is used at PAGASA since Dec. 2016. Discussion on the necessity of follow up training based on the result of seminar of HIMAWARI 8 image analysis on Feb. 2016.	

4. 3 Procurement plan of the equipment

(1) PC and OA equipment

Procurement plan of the equipment which was stipulated in the R/D of the J-POW Project is shown in Table 4-3-1. The following Table shows the list of provision of equipment completed by the year 2015.

Table 4-3-1 Breakdown of originally proposed equipment (OA equipment)

Equipment	Qty	Purpose
Desktop PC	2	PAGASA observation data acquisition Radar data edit Practice of guidance
Laptop PC	1	Awareness Raising Activity
Color Printer	2	Awareness Raising Activity
Graphic Software	1	Awareness Raising Activity
External Data Storage	1	PAGASA observation data acquisition
HDD (4TB)	5	PAGASA observation data acquisition
Virus Protect Software	3	Security for PC
Projector	1	Training in PAGASA, Awareness Raising Activity
Projector Screen	2	Training in PAGASA, Awareness Raising Activity
Scanner-Printer Compound Apparatus	1	Copy and Scan Document

Table 4-3-2 Provision of equipment (OA equipment)

Item	Manufacture	Remarks	Purpose	Qty	Location	Purchase Date
Desktop PC	HP	PAVILION 500-394D	PAGASA observation data acquisition	1	WFFC	2014/11/15
Desktop PC	FUJITSU	PY TX2540	Radar data edit Practice of guidance	1	WFFC	2015/6/2
Laptop PC	DELL	INSPIRON 3442	Awareness Raising Activity	1	Science Garden	2015/8/23
A3 Color Printer	Canon	IP8770	Awareness Raising Activity	1	Science Garden	2015/8/12
Mobile Color Printer	Canon	IP110	Awareness Raising Activity	1	Science Garden	2015/8/12
Graphic Software	Adobe	Photoshop CC	Awareness Raising Activity	1	Science Garden	2015/11/11
External Data Storage	Century	5Bay CRSJ535EU3S6G	PAGASA observation data acquisition	1	WFFC	2015/6/25
HDD (4TB)	WD	SATA 4TB	PAGAS observation data acquisition	5	WFFC	2015/6/25
Virus Protection Software	KASPERSKY	Internet Security for 5 licenses, one year	Security of PC	1	Science Garden, WFFC	2015/5/16
Projector	OPTOMA	X316-ST	Training in PAGASA, Awareness Raising	1	WFFC	2015/5/14

			Activity			
Projector Screen	OPTOMA	Tripod projection screen 60x60	Training in PAGASA, Awareness Raising Activity	2	Science Garden, WFFC	2015/8/12
Scanner-Printer Compound Apparatus	RICHO	Aficio MPC2030	Copy and scan documents	1	WFFC	2014/9/10

In order to achieve Outputs 2 and 3 of the J-POW Project, it is necessary to have access to observation data (such as surface observation, AWS, Radar) and incoming data (like satellite data and NWP). As PAGASA already stores this data on the data server, the Project will not collect this data independently but obtain it from the PAGASA's data server. With this in mind, the Project will design the system configuration in such a way that PAGASA will be able to operate by itself after the completion of the Project.

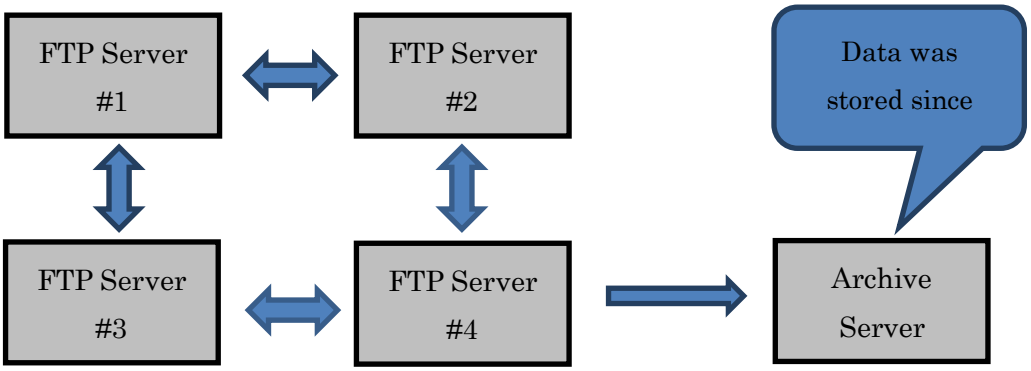


Figure 4-3-1 Meteorological data sharing in PAGASA

(2) Meteorological instruments calibration equipment

Originally proposed equipment for meteorological instruments calibration is shown in Table 4-3-4 below. However, the baseline survey found the current situation as follows:

2-1 Standard barometer of PAGASA is a mercury type.

2-2 Digital barometer is used as the sub-standard barometer of PAGASA.

2-3 Procurement of digital barometer as a traveling standard is in progress.

2-4 There is no calibration instrument for a digital barometer.

2-5 New liquid chamber for thermometer calibration is already installed.

The results of the baseline survey suggested that it would be beneficial for PAGASA to improve the equipment for digital barometer calibration. Based the consultation among JICA, JMA and C/P on this inspection, the procurement plan was adjusted as shown in Table 4-3-2 considering the specifications of necessary equipment, procurement method, procedures and so on. By the end of 2015, Procurement and provision of all the equipment were completed. Table 4-3-5 indicates the procurement and provision list of equipment.

Table 4-3-4 Breakdown of originally proposed equipment (Calibration equipment)

Equipment	Qty.	Purpose
Pressure adjustment pump	1	Digital barometer calibration
Pipe work, jigs and related parts	1	Digital barometer calibration
Liquid chamber	1	Thermometer calibration

Table 4-3-5 Procurement list of equipment

Item	Manufacture	Remarks	Purpose	Qty	Location	Purchase Date
Pressure Adjustment Pump	Daiichi Kagaku	Type -V1	Digital Barometer Inspection	1	Science Garden	(c) 29/5/2015
Pipe Work, Jigs and Related Parts	Daiichi Kagaku	Pipe work, jigs and related parts	Digital Barometer Inspection	1	Science Garden	29/5/2015
Digital Barometer	VAISALA	PTB-330TS	For PAGASA Standard Barometer	1	Science Garden	(d) 30/6/2015

4. 4 Equipment for ARG Network

In advance to the procurement of rain gauge and its equipment, all the items required for ARG network listed in Table 4-4-1 were agreed through discussion among JICA and C/P. These equipment were procured and were installed at each sites on July 2016. The system composition is shown in Fig. 4-4-1 and the location map of the sites are shown in Fig. 4-4-2, respectively.

Table 4-4-1

Item name	Products Company	Type	Number	Location	Date
Rain gauge （0.5mm） Calibrated by JMA	Climatec Inc.	CTKF-1-JM	8	Manito, Pilar, Barcelona, Rapu-rapu, Catarman, Lavezares Juban, Castilla	2016/5/6
Twist pair cable 3m	Climatec Inc.	C-KB-PO	8		2016/5/6
Data Logger	Campbell Scientific	CR200X	9	Legaspi, Manito, Pilar, Barcelona, Rapu-rapu, Catarman, Lavezares Juban, Castilla	2016/5/17
Solar Panel (20W)	Glomax	Bosca II	9		2016/5/17
Battery （12V 30A)	Inochi	12v18Ah/20Hr	9		2016/5/17
Charge Controller (5Amps)	Ace-tech	SC-10A	9		2016/5/17
GSM Module	InterCel	SAM 2W	9		2016/5/17
GSM Account (Single Stations, 2SIM account)	Smart Communications		9		2016/5/17
NEMA 4X	Ten-fold		9		2016/5/17
Electric Parts	Datalogger/modem/power supply peripherals		9		2016/5/17
Protect Fence	RZB Construction		9		2016/7/29
Data Acquisition Software	Campbell Scientific	Customized	2		2016/5/17

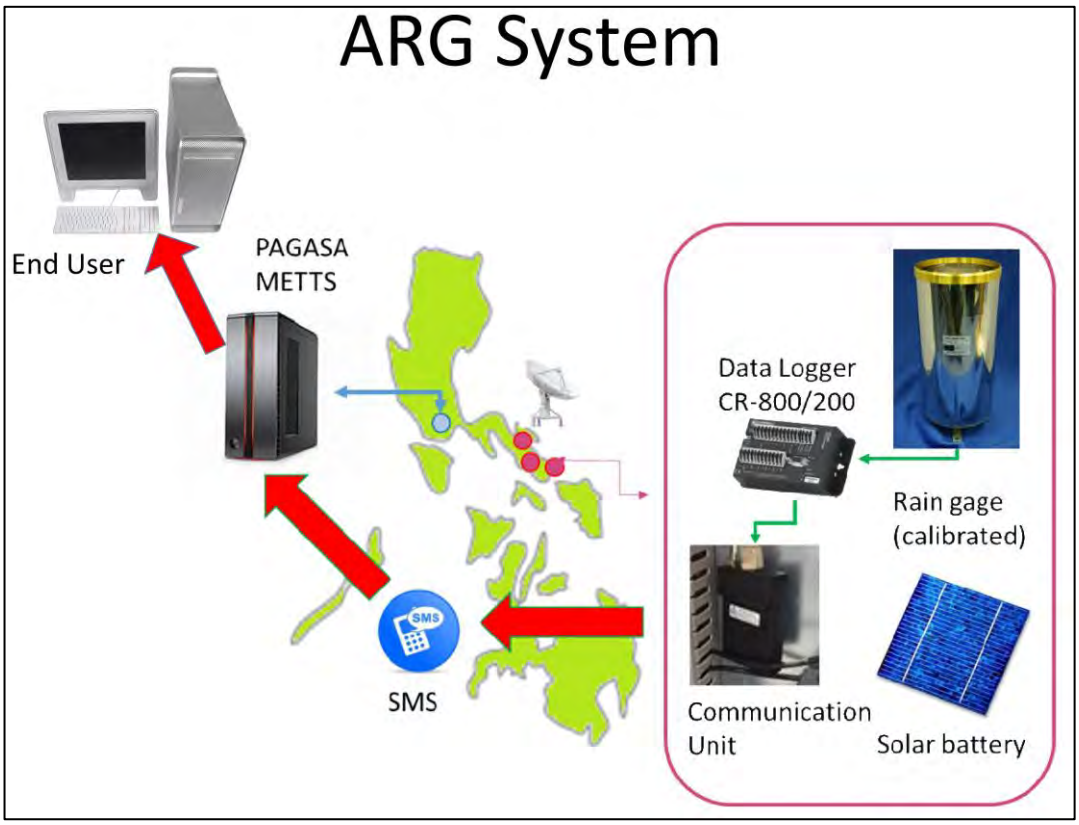


Figure 4-4-1　System Composition of ARG Network

Figure 4-4-2　Location Map of the ARG sites

J-POW PROJECT
Project Completion Report

Appendix

1. Project Design Matrix (PDM) Version 1.0
2. Project Flowchart
3. Assignment Plan
4. Minutes of Meeting (Joint Coordinating Committee)

Logical Framework (Project Design Matrix: PDM) (Version-1)

Project title: Project for Enhancing Capacity on Weather Observation, Forecasting and Warning
Project period: Three years (2014 – 2016)
Target group: PAGASA[1] Central Office; Southern Luzon PRSD[2] (as pilot) and other PRSDs (as non-pilot); Three Meteorological Radar Observation Stations (Virac/ Apari/ Guiuan); and LGUs
Target area: Operation areas of Southern Luzon PRSD (direct target); the whole country (indirect target)

Narrative Summary	Objectively Verifiable Indicators[3]	Means of Verification	Important Assumptions
Super Goal: Weather related disaster is mitigated.			
Overall Goal: Capacity of all PRSDs is enhanced in terms of weather observation, forecasting and warning.	1. More than 80% of LGUs in non-pilot PRSDs agree that laymanized meteorological information is timely delivered to them.	Results of questionnaires to concerned actors	
Project Purpose: Capacity of PAGASA Central Office and Southern Luzon PRSD is enhanced in terms of weather observation, forecasting and warning.	1. Average operation rate (i.e. data are provided to PAGASA from radars) of three radars becomes more than 80% in the third year. 2. Quantitative forecasting is issued by using weather guidance. 3. More than 80% of concerned actors (i.e. OCD; PCG; LGUs in pilot PRSD) agree that laymanized meteorological information is timely delivered to them in the third year.	Data record at Central Office Issued forecast Results of questionnaires to concerned actors	Government policy on PAGASA's mandate is unchanged.
Output 1: Capacity on weather observation is improved.	1-1 Traceability of Instrument is improved through development of reference guides regarding maintenance and calibration. 1-2 Capability of more than 80% of staff engaged in the maintenance and calibration of SYNOP/ AWS stations and RADAR stations is enhanced. 1-3 Maintenance reports on respective equipment (i.e. radars, synop stations and AWS) are regularly prepared and reported to the PAGASA Central Office.	Instrument traceability record. Result of pre and post training evaluation conducted by the project Maintenance reports	
Output 2: Capacity on meteorological data analysis and forecasting is improved.	2-1 Capability of 80% of the operational staff on the use of SATAID is improved. 2-2 Software for RADAR data calibration with rain gage data is developed. 2-3 Weather guidance is developed.	Pre and post training evaluation is conducted. Development of RADAR-AWS software. Weather guidance	
Output 3: Criteria of warnings are elaborated at Southern Luzon PRSD.	3-1 Criteria of warnings are made at the provincial level.	Criteria of warnings	

Appendix 1

<table>
<tr><td>Output 4:
Content and accessibility of meteorological information are improved.</td><td colspan="2">4-1 Laymanized and professional information are differentiated at PAGASA's website.
4-2 Meteorological information is timely transmitted by PAGASA Central Office to concerned agencies particularly DRRMC</td><td>PAGASA's website
Record on information transmission</td><td rowspan="2"></td></tr>
<tr><td>Output 5:
Activities of awareness-raising on meteorological information are improved at Southern Luzon PRSD.</td><td colspan="2">5-1 Program of awareness-raising is enhanced.
5-2 Result of the implementation of the program is reported.</td><td>Program plan
Program reports</td></tr>
<tr><td rowspan="2">Activities

1.1 Monitor the operation of newly introduced three radars and identify issues in their operations.
1.2 Provide trainings for obtaining quality data from three radars including maintenance of facilities and equipment.
1.3 Develop a guideline and provide training on quality control of radar data.
1.4 Identify current status and issues on maintenance of AWS and Synop observatory at the Southern Luzon pilot PRSD.
1.5 Develop manuals and plans for calibration and maintenance, and inspection guideline of AWS and Synop observatory at Southern Luzon PRSD.
1.6 Provide training on calibration and maintenance based on the above plans at Central Office and Southern Luzon PRSD.

2.1 Provide training on the operation of SATAID.
2.2 Develop software and provide training on methods to correct radar data by using surface observation data.
2.3 Provide training on weather guidance (Model Output Statistics).
2.4 Conduct of experiments on then use of GSM in WRF.

3.1 Conduct survey on current situation of warning and identify their challenges.
3.2 Elaborate methods to improve warnings and make criteria of warnings based on the above findings.

4.1 Identify challenges on the content of meteorological information.
4.2 Improve the content of meteorological information to be more user-friendly.
4.3 Improve ways of information dissemination to the concerned agencies particularly DRRMC.
4.4 Improve the content of website at Central Office and Southern Luzon PRSD.

5.1 Select pilot province(s) for awareness raising activities.</td><td colspan="2">Inputs</td><td rowspan="2">Trained staff remain working at concerned stations and offices.</td></tr>
<tr><td>Japan side

1. Experts
・ Chief Advisor/ Weather Forecasting
・ Surface Meteorological Observation
・ Radar Data Analysis
・ SATAID / Satellite Image Analysis
・ Meteorological Observation Technology
・ Weather Guidance
・ Operation and Maintenance of Radar
・ Weather Information / Information Technology
・ Weather Disaster Awareness Raising
・ Project Coordinator

2. Training in Japan

3. Equipment
・ Desktop Computer(s)
・ Printer(s)
・ Projector
・ Screen
・ Equipment related to training

4. Expenses
Expenses necessary for the implementation of the Project</td><td>Philippines side

1. Counterpart personnel
・ Project Director
・ Project Manager
・ Assistant Project Manager
・ Staff from Weather Division, PAGASA
・ Staff from Engineering and Technical Services Division, PAGASA
・ Staff from Research & Development and Training Division, PAGASA
・ Staff from Southern Luzon PRSD, PAGASA
・ Staff from National Capital Region PRSD, PAGASA

2. Project office and facilities

3. Expenses
Running expenses necessary for the implementation of the Project</td><td><u>Preconditions</u>
N/A</td></tr>
</table>

5.2 Assess local situation on the use of meteorological information. 5.3 Analyze causes of weather related disasters. 5.4 Identify challenges and propose list of activities to enhance awareness of local population on weather related disasters. 5.5 Prepare materials for awareness raising activities. 5.6 Conduct awareness raising activities and collect local feedback on awareness raising activities.			

Remark: 1. Philippine Atmospheric, Geophysical & Astronomical Services Administration
2. PAGASA Regional Services Division
3. Indicators should be refined upon the completion of the survey that is to be conducted during the initial 4-5 months of the project implementatio

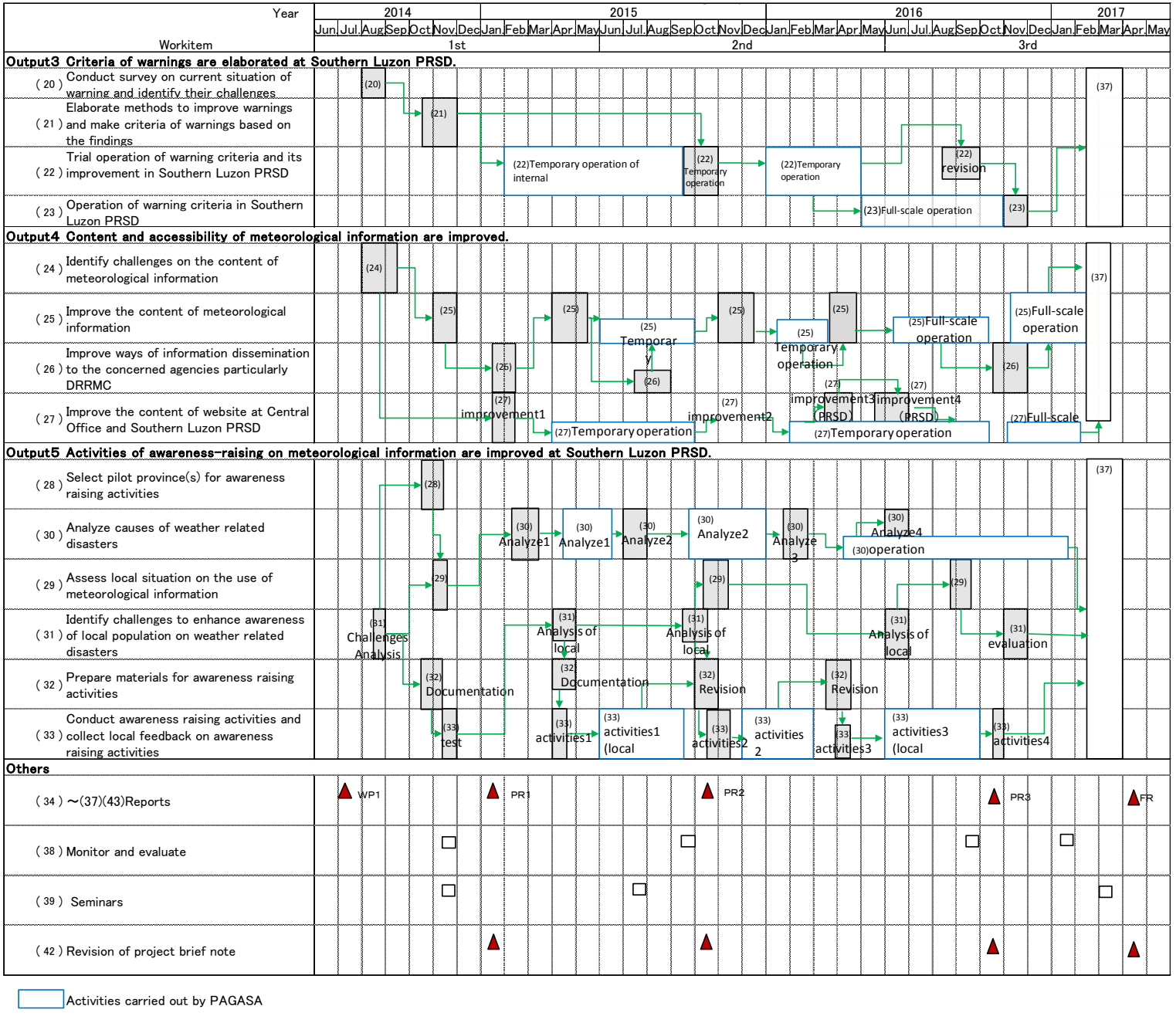
Plan of Operation (Version-1)

	1st Year				2nd Year				3rd Year			
	MJJ	ASO	NDJ	FMA	MJJ	ASO	NDJ	FMA	MJJ	ASO	NDJ	FMA
Output 1: Capacity on weather observation is improved.												
1.1 Monitor the operation of newly introduced three radars and identify issues in their operations.	■											
1.2 Provide training on maintenance for obtaining quality data from three radars.		■	■				■		■			
1.3 Develop a guideline and provide training on quality control of radar data.		■	■				■					
1.4 Identify current status and issues on maintenance of AWS and Synop observatory at Southern Luzon PRSD.	■	■										
1.5 Develop manuals and plans for calibration and maintenance, and inspection guideline of AWS and Synop observatory at Southern Luzon PRSD.		■			■		■			■		
1.6 Provide training on calibration and maintenance based on the above plans at the Central Office and Southern Luzon PRSD.			■			■			■		■	■
Output 2: Capacity on meteorological data analysis and forecasting is improved.												
2.1 Provide technical training on the operation of SATAID.		■					■		■			
2.2 Develop software and provide training on methods to correct radar data by using surface observation data.		■			■			■			■	
2.3 Provide training on weather guidance (Model Output Statistics).		■		■		■		■				
2.4 Conduct of experiments on then use of GSM in WRF.								■	■	■		
Output 3: Criteria of warnings are elaborated at Southern Luzon PRSD.												
3.1 Conduct survey on current situation of warning and identify their challenges.	■											
3.2 Elaborate methods to improve warnings and make criteria of warnings based on the above findings.		■				■			■	■		
Output 4: Content and accessibility of meteorological information are improved.												
4.1 Identify challenges on the content of meteorological information.	■	■										
4.2 Improve the content of meteorological information to be more user-friendly.		■		■		■	■	■				
4.3 Improve ways of information dissemination to the concerned agencies particularly DRRMC.			■		■					■		
4.4 Improve the content of website at the Central Office and Southern Luzon PRSD.			■			■	■	■	■		■	■
Output 5: Activities of awareness-raising on meteorological information are improved at Southern Luzon PRSD.												
5.1 Select pilot province(s) for awareness raising activities.	■	■										
5.2 Assess local situation on the use of meteorological information.	■	■				■			■	■		
5.3 Analyze causes of weather related disasters.			■	■	■		■		■			
5.4 Identify challenges and propose list of activities to enhance awareness of local population on weather related disasters.	■			■		■			■	■		
5.5 Prepare materials for awareness raising activities.		■		■		■		■				
5.6 Conduct awareness raising activities and collect local feedback on awareness raising activities.		■		■		■		■		■		

Appendix 2

Project flowchart

Year	2014							2015							2016							2017				
Workitem	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
	1st												2nd												3rd										
Domestic work 1																																			
(1) Data collection and survey for making work plan	(1)																																		
(2) Discussion on project basic policies and implementation methods	(2)																																		
(3) Settlement of draft work plan	(3)																																		
Field work																																			
(4) Consultation for the W/P	(4)		(4)																																
(5) Baseline survey			(5)																																
Output1 Capacity on weather observation is improved.																																			
(6) Analyze current status and issues for new Radar operation			(6)																																
(7) A draft of Radar maintenance manual					(7)																														
(8) Training for new Radar maintenance									(8)				(8)maiintenance				(8)			(8)maiintenance					(8)maiintenance										(37)
(15) Confirmation of maintenance activities with the maintenance manual at Radar sites																									(15)										
(9) Radar data quality control guideline					(9)																														
(10) Training for radar data quality control									(10) training1				(10 quality control				(10) training2			(10) quality control					(10) quality control										
(11) Investigation for equipment at AWS/SYNOP observatories			(11)																																
(41) Procurement of equipment						(41)																													
(12) 'Inspection guideline' and 'Calibration and maintenance manual'					(12)																														(37)
(13) Action plan for equipment maintenance at AWS/ SYNOP station					(13) Draft							(13)revision								(13) revision										(13) revision					
(14) Training for AWS/ SYNOP maintenance									(14) training1				(14) calibration and maintenance				(14) training2			(14) calibration and maintenance				(14) training3 PAGASA					(14) calibration and maintenance					
(16) Confirmation of maintenance activities with the maintenance manuals at AWS/ SYNOP observatories													(16)							(16)										(16)					
Output2 Capacity on meteorological data analysis and forecasting is improved.																																			
(17) Training on the operation of SATAID					(17) training1								(17)SATAID Temporary operation							(17) training2					(17)SATAID Full-scale operation						(17) training3				(37)
(18) Training on methods to correct Radar data by using surface observation data					(18) training1								(16) training2												(18) training3					(18)Temporary operation					
(19) Training on weather guidance (Model Output Statistics)			(19)		(19) training1								(19) training2 (19)Temporary operation of					(19) training3					(19)Temporary operation			(19) training4			(19)Full-scale operation					
(40) A training in Japan																		(40) Training in Japan																	


Year
Workitem
2014
2015
2016
2017
Jun Jul. Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul. Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul. Aug Sep Oct Nov Dec Jan Feb Mar Apr May
1st
2nd
3rd
Output3 Criteria of warnings are elaborated at Southern Luzon PRSD.
(20) Conduct survey on current situation of warning and identify their challenges
(21) Elaborate methods to improve warnings and make criteria of warnings based on the findings
(22) Trial operation of warning criteria and its improvement in Southern Luzon PRSD
(23) Operation of warning criteria in Southern Luzon PRSD
(20)
(21)
(22)Temporary operation of internal
(22) Temporary operation
(22)Temporary operation
(22) revision
(23)Full-scale operation
(23)
(37)
Output4 Content and accessibility of meteorological information are improved.
(24) Identify challenges on the content of meteorological information
(25) Improve the content of meteorological information
(26) Improve ways of information dissemination to the concerned agencies particularly DRRMC
(27) Improve the content of website at Central Office and Southern Luzon PRSD
(24)
(25)
(25) Temporary
(25) Temporary operation
(25)Full-scale operation
(25)Full-scale operation
(26)
(27) improvement1
(27)Temporary operation
(27) improvement2
(27) improvement3 (PRSD)
(27) improvement4 (PRSD)
(27)Temporary operation
(27)Full-scale
(37)
Output5 Activities of awareness-raising on meteorological information are improved at Southern Luzon PRSD.
(28) Select pilot province(s) for awareness raising activities
(30) Analyze causes of weather related disasters
(29) Assess local situation on the use of meteorological information
(31) Identify challenges to enhance awareness of local population on weather related disasters
(32) Prepare materials for awareness raising activities
(33) Conduct awareness raising activities and collect local feedback on awareness raising activities
(28)
(30) Analyze1
(30) Analyze1
(30) Analyze2
(30) Analyze2
(30) Analyze 3
(30) Analyze4
(30)operation
(29)
(31) Challenges Analysis
(31) Analysis of local
(31) Analysis of local
(31) Analysis of local
(31) evaluation
(32) Documentation
(32) Documentation
(32) Revision
(32) Revision
(33) test
(33) activities1
(33) activities1 (local
(33) activities2
(33) activities 2
(33) activities3
(33) activities3 (local
(33) activities4
(37)
Others
(34) ～(37)(43)Reports
(38) Monitor and evaluate
(39) Seminars
(42) Revision of project brief note
WP1
PR1
PR2
PR3
FR
Activities carried out by PAGASA

1. Work in Philippine

	Name	Assignment	Rating		Travel Times	2014 7	8	9	10	11	12	2015 1	2	3	4	5	6	7	8	9	10	11	12	2016 1	2	3	4	5	6	7	8	9	10	11	12	2017 1	2	3	4	5	Day Total	ManMonth Total
Work in Philippine	Chuji Yamamoto	Former PM Awareness Raising	2	Plan	4		(38日)			(45日)			(22日)						(21日)																					126	4.20
				Result	4		8/4 9/10 (38日)			10/19 12/2 (45日)			2/1 2/22 (22日)						8/2 8/22 (21日)																					126	4.20
	Michihiko TONOUCH	PM Radar Technology	3	Plan	8	(4日)				(13日)			(14日)				(14日)				(14日)				(14日)				(14日)					(15日)					(13日)		129	4.30
				Result	11	7/13-19 (4日)				11/3-15 (13日)			2/1-5 2/18-3/4 (14日)					7/2/17 (16日)				11/24-12/8 (15日)		1/26-2/3 (9日)	2/11-20 (10日)			5/16-20 (5日)	6/2-18 (17日)				10/12-26 (15日)						4/18 - 4/27 (10日)		128	4.27
	Masao MIKAMI	Sub PM Awareness Raising	2	Plan	6																		(24日)		(30日)				(30日)			(30日)		(17日)		(28日)			(15日)		174	5.80
				Result	10																10/1-9 (9日)	11/2-6 (5日)		1/14-30 (17日)		3/6-16 (11日)	4/12/28 (17日)		5/24-6/17 (25日)		7/13-8/3 (19日) (3日)		9/8-25 (39日)	9/27-10/19				1/25-2/14 (21日)			4/3 - 4/26 (24日)		190	6.33
	Koji MATSUBARA	Meterological Observation Technology	3	Plan	9		(28日)		(45日)				(30日)						(30日)				(43日)			(30日)				(30日)			(20日)							(20日)	(7日)		283	9.43
				Result	11		8/17 9/13 (28日)			10/19 12/2 (45日)			2/12 3/13 (30日)						7/23 8/20 (29日)				10/18-11/14 11/22-28 (28日) (7日)				3/6-31 (26日)			5/31-6/8 (9日)	6/23-7/23 (27日)			9/26 10/22 (27日)						4/9 - 4/22 (14日)		270	9.00
	Hiroshi YAMAGUCHI	Radar Maintenance Software	3	Plan	2		(27日)		(14日)																																41	1.37
				Result	2		8/4 8/30 (27日)			10/19-11/1 (14日)																																41	1.37
	Masaru WAKABAYASHI	Radar Maintenance Hardware	3	Plan	3																		(16日)		(32日)				(35日)												83	2.77
				Result	3																		11/26-12/12 (7日)		2/8 3/16 (38日)				5/19 6/14 (28日)												83	2.77
	Masahiro NAGASHIMA	Radar Maintenance Software	3	Plan	1																		(8日)																		8	0.26
				Result	1																		11/26-12/3 (8日)																		8	0.26
	Ryusuke TAIRA	Guidance	3	Plan	11			(14日)		(30日)				(16日)			(15日)	(15日)				(15日)		(15日)				(15日)				(15日)					(32日)		(15日)		212	7.07
				Result	12			(14日)		(30日)			2/26-3-13 (16日)				5/10-5/23 (14日)		7/2-7/17 (16日)	8/9-8/21 (13日)				(17日)				(14日)			(14日)					2/5-17 (13日)		4/9 - 4/22 (14日)		200	6.67
	Koji MITSUHASHI	Meceorological Info./Info. Technology	3	Plan	10		(45日)			(30日)			(30日)						(21日)				(28日)		(30日)				(30日)			(21日)		(15日)							250	8.33
				Result	9		8/4 9/13 (41日)			10/19 11/21 (34日)			2/1 3/2 (30日)						8/5-25 (21日)			10/25 12/11 (48日)			2/8 3/4 (26日)			4/10-27 (18日)	5/22-6/11 (21日)				9/25-10/5 (11日)								250	8.33
	Shizuko KOMATSU	Awareness Raising	4	Plan	9		(17日)			(21日)			(20日)				(15日)		(20日)		(15日)		(20日)																		128	4.27
				Result	7		8/25-9/10 (17日)			11/12-12/2 (21日)			2/1-3/2 (20日)				5/10-5/23 (14日)			8/5-8/25 (21日)	9/27-10/9 (13日)	10/22-11/12 (22日)																		128	4.27
	Ikuko INOUE	Awareness Raising	4	Plan	2																												(29日)					(21日)			50	1.66
				Result	2																											9/21 10/19 (29日)					3/30 4/28 (30日)			59	1.96
																																							Sub-total Plan	1484	49.46
																																							Sub-total Result	1483	49.43

2. Work in Japan

	Name	Assignment	Rating																																							
Work in Japan	Chuji Yamamoto	Former PM Awareness Raising	2	Plan								(2日)																													2	0.10
				Result								(2日)																													2	0.10
	Michihiko TONOUCH	PM Radar Technology	3	Plan																		(10日)																			10	0.50
				Result																		(10日)																			10	0.50
	Masao MIKAMI	Sub PM Awareness Raising	2	Plan															(2日)										(2日)							(2日)		(2日)			8	0.40
				Result																				(2日)													(2日)	(2日)	(3日)			8.5	0.43
																																							Sub-total Plan	20	1.00
																																								Sub-total Result	20.5	1.03

Legend : Assignment result Assignment plan Consu

Total	Plan	**50.46**
	Result	**50.46**

Reports	△PR3	△PR3	△PR3	△FR

MINUTES OF MEETING
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
PHILIPPINE ATMOSPHERIC, GEOPHYSICAL
AND ASTRONOMICAL SERVICES ADMINISTRATION,
DEPARTMENT OF SCIENCE AND TECHNOLOGY
ON
THE TECHNICAL COOPERATION PROJECT
FOR ENHANCING CAPACITY ON WEATHER OBSERVATION,
FORECASTING AND WARNING

Japan International Cooperation Agency (hereinafter referred to as "JICA"), the Philippine Atmospheric, Geophysical and Astronomical Services Administration, The Department of Science and Technology (hereinafter referred to as "PAGASA-DOST") and other Philippine authorities concerned have discussed several major issues during the First Joint Coordinating Committee Meeting for the Technical Cooperation Project for Enhancing Capacity on Weather Observation, Forecasting and Warning (hereinafter referred to as "The Project"). The list of the participants is shown in Appendix 1.

Both Philippine and Japanese sides exchanged views with respect to the desirable measures to be taken by the PAGASA-DOST and the Project Team for the successful implementation of the Project.

As a result of the discussions, the PAGASA-DOST and the Project Team have agreed on the matters referred in the document attached herewith.

Quezon City
18th July 2014

Mr. Nobuo Sato Chief Advisor and Expert on Weather Forecasting/Administration	Dr. Vicente B. Malano Acting Administrator, Philippine Atmospheric, Geophysical and Astronomical Services Administration, Department of Science and Technology

Witness by

Mr. Noriaki Niwa Chief Representative JICA Philippine Office	

Highlights of the Meeting

The JICA Project Team (hereinafter referred to as The JICA Team) made the presentations on "Introduction of Project", "Challenges of PAGASA", "For Reliable and Friendly Weather Information" and "Coordination and Public Relations" and explained the main points of The Project as follows. (Appendix 2: Handouts of JCC meeting)

1, Overview of the Project

1-1, Background

In the last few decades, JICA and PAGASA have been cooperating in establishing the systems such as the Flood Forecasting and Warning System to mitigate and prevent natural disasters and improve socio-economic conditions. In order to protect life and property from tropical cyclone damage effectively, three (3) Doppler radars have been installed in Virac, Aparri and Guiuan under Japan's Grant Aid Assistance scheme (signed on 13th November 2009) by the request of the Government of the Philippines. It is necessary that those procured equipment and installed systems are to be fully utilized for dissemination of the meteorological and disaster related information to the public and disaster management agencies. In order to strengthen the capacity to utilize the system and disseminate the information, The Project was requested by the Government of the Philippines and was inaugurated in June 2014.

1-2, Overall Goal

Capacity of all PAGASA Regional Services Divisions (hereinafter referred to as "PRSD") is enhanced in terms of weather observation, forecasting and warning.

1-3, Outputs

Output 1: Capacity on weather observation is improved.
Output 2: Capacity on meteorological data analysis is improved.
Output 3: Criteria of warnings are elaborated at Southern Luzon PRSD.
Output 4: Contents and accessibility of meteorological information are improved.
Output 5: Activities of awareness rising on meteorological information are improved at Southern Luzon PRSD.

1-4, Project Area

National Capital Region (hereinafter referred to as NCR) and Southern Luzon PRSD

1-5, Experts

Long-term experts:
Mr. Nobuo Sato: Chief Advisor and Expert on Weather Forecasting/ Administration
Ms. Yumi Schultz: Project Coordinator and Expert on Public Relation/ Training Planning

Short-term experts:
Mr. Chuji Yamamoto: Leader of Short-term Expert team/ Weather Disaster Awareness Raising
Mr. Michihiko Tonouchi: Deputy Leader of Short-term Expert team/ SATAID
Mr. Hiroshi Matsubara: Weather Observation Technologies
Mr. Koji Mitsuhashi: Weather Information and ICT
Weather Guidance Expert
Radar Operation and Maintenance Expert
Weather Information Awareness Expert

1-6, Trainings

Nov. 2014: Guidance-1, SATAID-1
Feb. 2015: RADAR maintenance-1, RADAR data quality control-1,
AWS/SYNOP maintenance-1 and RADAR data usage-1
May 2015:Guidance-2
Jul. 2015: RADAR data usage-2
Oct. 2015:Guidance-3
Nov. 2015: RADAR maintenance-2, RADAR data quality control-2 and
AWS/SYNOP maintenance-2
Feb. 2016: SATAID-2 and RADAR data usage-3

1-7, Seminars

Nov. 2014: "Typhoon and storm surge"
Jul. 2015: "Disaster prevention activity at local level"
Mar. 2017: "Weather information for reduction of natural disaster risks"

1-8, Material Production

-RADAR maintenance manual (Maintenance manual, Maintenance report and Manual for troubles)
-RADAR data quality control guideline (Operation report, RADAR data quality control and Quality control manual)
-Manuals for maintenance and calibration
-Trial weather guidance for the pilot provinces
-Educational materials for public awareness

1-9, Revision of Project Design Matrix

The Project Design Matrix (hereinafter referred to as PDM) (Version-0) was once set as attached on 24th January 2014. However, concerning to the loss of Guiuan Radar in Eastern Samar, the support until September 2015 can be included into the project without revising the current PDM.

In addition, indicators should be reviewed to be practical ones through The Project coordinators'

meeting and mutual monitoring conducted by The JICA Team, PAGASA and JICA Philippine Office.

1-10, JCC members

Chairperson: Administrator of PAGASA

Members of Philippine Side

PAGASA: Weather Division, Engineering and Technical Service Division, HMD, R&D and Training, PRSD (Northern Luzon, NCR, Southern Luzon, Visayas, Mindanao)

DOST- International and Technical Cooperation Unit, NEDA, OCD, PCG, DepEd, DILG and Others appointed by PAGASA

Members of Japanese Side

Chief Representative of JICA Philippines

Experts dispatched by JICA

Mission Member dispatched by JICA

Other person(s) concerned appointed by JICA

2, Key Points of The Project

2-1, Challenges for PAGASA

The Project Chief Advisor identified that the quality assurance of observations including verification of forecast / warning products, exchange of observation data among governmental agencies and LGUs, coordination among Governmental agencies and the public, Numerical Weather Prediction (hereinafter referred to as NWP) development, high speed communication links nationally and Internationally, and automatization of daily tasks are significantly crucial.

2-2, Implementation Policies of The Project

The Project is implemented based on the following six (6) policies, (i) to transfer Japan's experience and skills under close coordination and cooperation with JMA, (ii) to conduct works based on WMO policies, (iii) to contribute to other countries through accurate observation and prompt data forwarding, (iv) to record all technical transfer activities (i.e. activities for radar operation, maintenance, AWS maintenance and inspection, radar data, SATAID, weather guidance usage, web site improvement and public awareness raising activities) into documents for reference and verification in the future, (v) to ensure appropriate technical skills to support the above (iv) transferred through the review and improvement of documents and (vi) to produce and improve public awareness materials based on feedback from users.

2-3, Public Awareness

In relation to public awareness, important keys are; (i) to take a holistic view of the public/target groups and end users; (ii) to determine appropriate media (mass media/print media/ internet and others) and; (iii) to ensure media is user friendly.

2-4, Counterpart Cost

JICA informed that the counterpart cost to be essentially covered by the Philippine side. The counterpart cost includes, i.e., the installation fee for JICA supported equipment, Counterpart (hereinafter referred to as C/P) domestic travel fee, and the registration fee for the conferences, etc. In case if there are difficulties for the Philippine side, JICA will consider covering the cost based upon the official request from the Philippine side.

2-5, Terms to be confirmed

*Materials for the baseline survey

+ Observation/maintenance manuals (Radar & Automatic Weather Observation System)
+ Forecast procedure manuals and guidelines
+ Weather information samples to be issued to the concerned authorities and to the public
+ Direct user list of weather information (include types of communication tool)
+ Educational activity schedule and materials

Discussions of the Meeting

The followings are the main subjects discussed and/or agreed during the JCC meeting.

1, Pilot Provinces for Awareness Raising Activities

The Philippine side requested to have pilot provinces excluding Albay province due to the reason that the level of disaster awareness in Albay province is relatively high compared to other provinces. The JICA Team explained that a pilot province can be re-examined; however, the pilot province must be within the pilot PRSD since all the outputs and activities are linked each other. Both side agreed to discuss further details in the coordinators' meeting in order to set the pilot province(s).

2, Radar Maintenance Training

The Philippine side requested to have the radar maintenance training not only for the personnel from Virac and Aparri radar stations, but also from Guiuan radar station and the Central Office. The JICA Team replied that the personnel from Guiuan radar station can also join the trainings in Virac and Aparii.

3, Collaboration with Philippines Meteorological Society

The Project manager (The Philippine side) is also the president of Philippines Meteorological Association (hereinafter referred to as PMS) and PMS has a close partnership with PAGASA since most of the members are from PAGASA. Therefore, the Project manager (The Philippine side) mentioned that PMA welcomes the idea to cooperate with The JICA Team. PMS conducts the annual convention, which is scheduled on November 2014 and invites the JICA Team as a resource speaker to introduce The Project.

4, Dvorak Technique Training

The Philippine side requested to have an additional lecture on Dvorak technique during the training on SATAID. The JICA Team replied that experts from Japan Meteorological Agency (hereinafter referred to as JMA) are scheduled to arrive at PAGASA in autumn 2015. The training will focus on the analyses of tropical disturbances including Dvorak techniques using images from the next generation Himawari-8 satellite, which will be launched in October 2014.

5, Numerical Weather Prediction

The Philippine side requested The JICA Team to draw up a Numerical Weather Prediction (hereinafter referred to as NWP) development plan for PAGASA. The JICA Team replied that it is essential to think of a long span of time since NWP requires a lot of technical expertise and time to operate it properly. The JICA Team added that a plan for NWP development in PAGASA can be provided considering the JMA plans / experiences.

6, Electronic Public Awareness Campaign

The Philippine side asked whether the project also deals with the electronic version of the public awareness campaign used in considering the growth of social media in the Philippines. The JICA Team replied that this matter will be discussed in The Project coordinators' meeting since the baseline survey team including an expert on Information and Communication Technology is scheduled to come in August 2014.

(End of discussion)

Appendix 1: List of participants of JCC meeting
Appendix 2: Hand-outs of JCC meeting

MINUTES OF MEETING
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
PHILIPPINE ATMOSPHERIC, GEOPHYSICAL
AND ASTRONOMICAL SERVICES ADMINISTRATION,
DEPARTMENT OF SCIENCE AND TECHNOLOGY
ON
PROJECTFOR ENHANCING CAPACITY ON WEATHER OBSERVATION, FORECASTING AND WARNING

Japan International Cooperation Agency (hereinafter referred to as "JICA"), the Philippine Atmospheric, Geophysical and Astronomical Services Administration, The Department of Science and Technology (hereinafter referred to as "PAGASA-DOST") and other Philippine authorities concerned have discussed several major issues during the Second Joint Coordinating Committee (hereinafter referred to as "JCC")Meeting for the Project for Enhancing Capacity on Weather Observation, Forecasting and Warning (hereinafter referred to as "J-POW Project")on 27th November, 2014 in Seameo Innotech. The list of the participants is shown in Appendix 1.

Both Philippine and Japanese sides exchanged views with respect to the desirable measures to be taken by the PAGASA-DOST and the Project Team for the successful implementation of the Project.

As a result of the discussions, the PAGASA-DOST and the Project Team have agreed on the matters referred in the document attached herewith.

Quezon City, 27th November 2014

Mr. Nobuo Sato
Chief Advisor and Expert on Weather Forecasting/Administration

Dr. Vicente B. Malano
Acting Administrator,
Philippine Atmospheric, Geophysical and Astronomical Services Administration, Department of Science and Technology

Witness by

Mr. Noriaki Niwa
ChiefRepresentative
JICA Philippines Office

Highlights of the Meeting

The JICA Philippine office made the presentation titled “Updates of JICA’s program” and explained the further strategy development at PAGASA. The JICA Project Team (hereinafter referred to as The J-POW project Team) made the presentations on “Status of J-POW Project”, “Presentation of revised PDM, PO and C/P list” and “Presentation on the Development of Quantitative Precipitation Forecast” and explained the current status of The Project as follows. (Appendix 2: Handouts of JCC meeting)

1, Updates of JICA’s program

In the last few decades, JICA and PAGASA have been cooperating in establishing the systems such as the Flood Forecasting and Warning System to mitigate and prevent natural disasters and improve socio-economic conditions.

2, Status of J-POW Project m

2-1, Output 1-a “Capacity development on Radar observation and Radar Data Quality Control”

In the last few decades, JICA and PAGASA have been cooperating in establishing the systems such as the Flood Forecasting and Warning System to mitigate and prevent natural disasters and improve socio-economic conditions.

2-2, Output 1-b “Capacity development on weather observation”

In the last few decades, JICA and PAGASA have been cooperating in establishing the systems such as the Flood Forecasting and Warning System to mitigate and prevent natural disasters and improve socio-economic conditions.

2-3, Output 2-a “Capacity development on weather forecast SATAID and Radar Connection”

In the last few decades, JICA and PAGASA have been cooperating in establishing the systems such as the Flood Forecasting and Warning System to mitigate and prevent natural disasters and improve socio-economic conditions.

2-4, Output 2-b “Capacity development on Weather Guidance”

In the last few decades, JICA and PAGASA have been cooperating in establishing the systems such as the Flood Forecasting and Warning System to mitigate and prevent natural disasters and improve socio-economic conditions.

2-5, Output 3 “Criteria of warnings are elaborated at Southern Luzon PRSD”

In the last few decades, JICA and PAGASA have been cooperating in establishing the systems such as the Flood Forecasting and Warning System to mitigate and prevent natural disasters and improve socio-economic conditions.

2-6, Output 4 “Improvement of contents and accessibility on meteorological information”

In the last few decades, JICA and PAGASA have been cooperating in establishing the systems such as the Flood Forecasting and Warning System to mitigate and prevent natural disasters and improve socio-economic conditions.

2-7, Output 5 “Improvement of awareness-raising activities at Southern Luzon PRSD”

In the last few decades, JICA and PAGASA have been cooperating in establishing the systems such as the Flood Forecasting and Warning System to mitigate and prevent natural disasters and improve socio-economic conditions.

3, Presentation of revised PDM, PO and C/P list

3-1, PDM
In the last few decades, JICA and PAGASA have been cooperating in establishing the systems such as the Flood Forecasting and Warning System to mitigate and prevent natural disasters and improve socio-economic conditions.

3-2, PO
In the last few decades, JICA and PAGASA have been cooperating in establishing the systems such as the Flood Forecasting and Warning System to mitigate and prevent natural disasters and improve socio-economic conditions.

3-3, C/P list
In the last few decades, JICA and PAGASA have been cooperating in establishing the systems such as the Flood Forecasting and Warning System to mitigate and prevent natural disasters and improve socio-economic conditions.

4, Presentation on the Development of Quantitative Precipitation Forecast

1-1, Background
In the last few decades, JICA and PAGASA have been cooperating in establishing the systems such as the Flood Forecasting and Warning System to mitigate and prevent natural disasters and improve socio-economic conditions.

In order to protect life and property from tropical cyclone damage effectively, three (3) Doppler Radars have been installed in Virac, Aparri and Guiuan under Japan's Grant Aid Assistance scheme (signed on 13th November 2009) by the request of the Government of the Philippines. It is necessary that those procured equipment and installed systems are to be fully utilized for dissemination of the meteorological and disaster related information to the public and disaster management agencies. In order to strengthen the capacity to utilize the system and disseminate the information, The Project was requested by the Government of the Philippines and was inaugurated in June 2014.

1-2, Overall Goal
Capacity of all PAGASA Regional Services Divisions (hereinafter referred to as "PRSD") is enhanced in terms of weather observation, forecasting and warning.

1-3, Outputs
Output 1-a: Capacity development on Radar observation and Radar Data Quality Control
Output 1-b: Capacity development on weather observation.
Output 2-a: Capacity development on weather forecast SATAID and Radar Connection.
Output 2-b: Capacity development on Weather Guidance
Output 3: Criteria of warnings are elaborated at Southern Luzon PRSD.
Output 4: Improvement of contents and accessibility on meteorological information.
Output 5: Improvement of educational activities in Southern Luzon PRSD.

1-4, Project Area
National Capital Region (hereinafter referred to as NCR) and Southern Luzon PRSD

1-5, Experts
Long-term experts:
Mr. Nobuo Sato: Chief Adviser and Expert on Weather Forecasting/ Administration
Ms. Yumi Schultz: Project Coordinator and Expert on Public Relation/ Training Planning

Short-term experts:
Mr. Chuji Yamamoto: Leader of Baseline Survey team/ Raising Public Disaster Awareness Expert

Mr. Michihiko Tonouchi: Deputy Leader/SATAID
Mr. Hiroshi Matsubara: Weather Observation Technologies
Mr. Koji Mitsuhashi: Weather Information and ICT
Mr. Ryusuke Taira - Weather Guidance Expert
Mr. Hiroshi Yamaguchi - Radar Operation and Maintenance Expert
Ms. Shizuko Komatsu – Raising Public Awareness Expert

1-6, Trainings

Nov. 2014: Guidance-1, SATAID-1
Feb. 2015: Radar maintenance-1, Radar data quality control-1, AWS/SYNOP maintenance-1 and Radar data usage-1
May 2015: Guidance-2
Jul. 2015: Radar data usage-2
Oct. 2015: Guidance-3
Nov. 2015: Radar maintenance-2, Radar data quality control-2 and AWS/SYNOP maintenance-2
Feb. 2016: SATAID-2 and RADAR data usage-3

1-7, Seminars

Nov. 2014: "Typhoon and storm surge"
Jul. 2015: "Disaster prevention activity at local level"
Mar. 2017: "Weather information for reduction of natural disaster risks"

1-8, Material Production

-Radar maintenance manual (Maintenance manual and report; and Troubleshooting Manual)
-Radar data quality control guideline (Operation report, Radar data quality control and Quality control manual)
-Manuals for maintenance and calibration
-Trial weather guidance for the pilot provinces
-Educational materials for public awareness

1-9, Revision of Project Design Matrix

The Project Design Matrix (hereinafter referred to as PDM) (Version-0) has one set attached on 24th January 2014. However, concerning to the loss of Guiuan Radar in Eastern Samar, the support until September 2015 can be included into the project without revising the current PDM.

In addition, indicators should be reviewed to be practical once through Project coordination meeting and mutual monitoring conducted by JICA Team, PAGASA and JICA Philippine Office.

1-10, JCC members

Chairperson: Administrator of PAGASA
Members of Philippine Side

I. PAGASA: Weather Division, Engineering and Technical Service Division, FPMD, RDTD, PRSD (NCR, Northern Luzon, Southern Luzon, Visayas and Mindanao)

DOST- International and Technical Cooperation Unit, NEDA, OCD, PCG, DILG, PCIEERD and Others appointed by PAGASA

Members of Japanese Side

Chief Representative of JICA Philippines
Experts dispatched by JICA
Mission Member dispatched by JICA
Other person(s) concerned appointed by JICA

2, Key Points of the Project

2-1, Challenges for PAGASA

The Project Chief Advisor identified that the quality assurance of observations including verification of forecast / warning products, exchange of observation data among government agencies and LGUs, coordination among Government agencies and the public, Numerical Weather Prediction (hereinafter referred to as "NWP") development, high speed communication links national and International, and automation of daily tasks are significantly crucial.

2-2, Implementation Policies of the Project

The Project is implemented based on the following six (6) policies, (i) to transfer Japan's experience and skills under close coordination and cooperation with JMA, (ii) to conduct works based on WMO policies, (iii) to contribute to other countries through accurate observation and prompt data forwarding, (iv) to record all technical transfer activities (i.e. activities for Radar operation, maintenance, AWS maintenance and inspection, Radar data, SATAID, weather guidance usage, web site improvement and public awareness raising activities)into documents for reference and verification in the future, (v) to ensure appropriate technical skills to support the above (iv)to conduct training activities through continuous verification and evaluation of processes and outputs and (vi) to produce and improve public awareness materials based on feedback from users.

2-3, Public Awareness

In relation to public awareness, important keys are; (i) to take a holistic view of the public/target groups and end users; (ii) to determine appropriate media (mass media/print media/ internet and others) and; (iii) to ensure media is user friendly.

2-4, Counterpart expenditure

JICA informed that the counterpart expenses to be essentially covered by the Philippine side. The counterpart expenses include, i.e., the installation fee for JICA supported equipment, Counterpart (hereinafter referred to as C/P) domestic travel fee, and the registration fee for the conferences, etc. In case if there are difficulties from Philippine side, JICA will consider to shoulder the expenses upon the official request of the Philippine side.

2-5, Terms to be confirmed

*Materials for the baseline survey

+ Observation/maintenance manuals (Radar& Automatic Weather Observation System)
+ Forecast procedure manuals and guidelines
+ Weather information samples to be issued to the concerned authorities and to the public
+ Direct user list of weather information (include types of communication tool)
+ Educational activity schedule and materials

Discussions of the Meeting

I. The meeting started at 09:25AM

II. The meeting was presided over and call to order by Acting Administrator Dr. Vicente Malano and gave an overview of the project and some issues raised during the last JCC Meeting that was held last July. Thanking the support of the JICA Experts on this project and the participants attended the meeting.

- Dr. Landrico Dalida welcoming the attendees presents on this meeting and gave some introduction of the project.
- Some remarkable words from Mr. Takahiro Morita, Senior Representative of JICA Philippine Office, thanking PAGASA for acknowledging this on-going J-POW Project.

III. The first presentation was presented by Mr. Hayato Nakamura, Project Formulation Adviser, updating everyone on the on-going JICA program. Since PAGASA have requested JICA to support awareness activities, JICA had formed two groups, which are the JOCV and SV. JICA also send a short term volunteer for Yolanda rehabilitation. The groups have started the awareness activity in Albay and Leyte. In January next year, the group will start to distribute the awareness materials in Antique and Kalibo, Aklan. Also JICA creates a partnership program with counterparts from Japan in different regions but this project still for preparation for the next project of JICA with PAGASA. Yolanda Rehabilitation is until March 2015. Dr. Malano commended this rehabilitation as a fast track project in Guiuan. J-POW Project has plans in PRSD for awareness on February 2015. J-POW will expand the awareness plan in Visayas and other regions. July is the month of awareness activity. Hoping that other regions will also benefit in this awareness activity led by PAGASA.

IV. The second presenter is Mr. Chuji Yamamoto, the Leader of the Technical Expert Team for the progress of J-POW Project. He gave some introduction of the project which start last May 2014 and expected to finish by March or August 2017. Started to discussed the following output:

a. Output 1-a (Radar maintenance and operation). Keyword for this activity issues on operation, maintenance of facilities and equipment and guideline which provide training on quality control.

Mr. Yamamoto recommends comprehensive manuals, for operation skills of generators, power supply and radar. The team had visited the radar sites in Aparri, Viract and Guiuan. The following are the status of their observations and reports. Consumables and inspection are not effectively used in some sites. Some generators operating hours are not in good condition example in Aparri 100hrs/mon, Virac 160hrs/mon and Guiuan 500hrs/mon in which Guiuan should have 702hrs/mon and should operate 17hrs per day. In Guiuan the generator fuel cannot read and need to change the battery to run operationally. The only operating hours read from Guiuan radar is 2000hrs in 4mon. Mr. Yamamoto also recommends a periodic inspection of the machine, review and upgrade of the comprehensive manual to develop data quality control guidance and conducting training for maintenance and observation data. In connection with Output 1-a, some information have been raised by Dr. Malano.

- *Dr. Malano asked the team if there are investigations made to discover the problem encountered in the generator that was used only half of the month in radar site while this generator are frequently used than the commercial power.*
- *As per Mr. Sato, commercial power is frequently unstable which due to trigger the problem of generator.*
- *As per Dr. Malano, the problems encountered from the Radar site are due to the supply of commercial power not by PAGASA.*
- *Mr. Yamamoto confirmed that it is not a problem of PAGASA because of unstable commercial*

power change and the status is recorded in the report.

b. Output 1-b (Surface observation, calibration and inspection). The keyword is Traceability system international (SI) an example of this is the degrees in temperature in one country which should not be different from other country. This activity is to identify the current status and issues on maintenance and training for calibration and maintenance of AWS and Synop observatory in SL PRSD. Because the Virac radar site covers the pilot province of Sorsogon and Northern Samar but has different calibration result, in which they have supposed to have the same result. An exchange of question and answer has been raised.

- *Ms. Bobot asked regarding traceability, if it suggest all calibration data should be available to PAGASA which pertains to AWS. Mr. Yamamoto said that traceability is also recommended by WMO.*
- *Mr. Matsubara suggests to PAGASA a proper maintenance of AWS system, as the result of the survey found that there are defective AWS on the site.*
- *According to Dr. Malano, it is hard to maintain the AWS when it has no manual instrumentation, but those that has, AWS are properly maintained.*
- *Dir. Tabell of DILG, asked that although AWS has function to measure the temperature, rain gauge, etc., is there other devices provided by AWS which have different components.*
- *According to Dr. Malano, it is depend on the manufacturers that provide AWS, as other manufacturer can integrate other functions to other system like AWS manufactured by Data Logger.*

c. Output 2-a (SATAID and Radar data analysis). The keyword is SATAID means Satellite Animation and Interactive Diagnosis provide by JMA which has many functions for weather analysis and quantitative weather forecast and QPE means Quantitative Precipitation Estimation is to get an accurate result and to correct Radar data in intensity of rainfall and rain gauge data, which launched last October, through a proper arrangement if this is still operational until July, the team will conduct a SATAID training. Currently, SATAID are already used in WFS, TAMSS, AMSS and MDIES to monitor cloud situation and NWP forecast. But Radar data and AWS data are not used for SATAID. QPE confirmed rain gauge station which can provide hourly precipitation data is almost 40. Mr. Yamamoto recommends using SATAID by PAGASA and QPE to use in Virac. Sharing of information between PAGASA and JICA experts.

- *Dr. Malano asked the team if SATAID is capable of integrating all radar data. Mr.Sato answered this as NO, as this is not provided in the software itself. This was previously discussed by Mr. Tonouchi to PAGASA that during the baseline survey, he requests to PAGASA to provide him the data format of the power radar so that he will search for the software and he promised to find ways to integrate the PAGASA radar to SATAID program.*
- *Dr. Malano, asked in case the radar is Japanese made, should all the radar data have the same format, if that is the case all radar formats can be integrated in SATAID. This was confirmed by Raymond to Dr. Malano.*
- *Dr. Malano asked the team if by using the existing facilities of PAGASA, can PAGASA received information from Himawari without any upgrading. As per Mr. Sato, in using Himawari, it could be 15x more high speed in receiving data.*
- *Dr. Malano suggests to upgrade the existing facilities in order to receive all Himawari data through internet.*

d. Output 2-b (Weather Guidance). The keyword is Weather Guidance a method to translate GPV means Grid Point Value which was resulted to Numerical Weather Prediction output to contact weather forecast. Weather guidance improved the 3 hourly data of Synop observation and should be archived as digital basis. It should be recorded in real time basis.

e. Output 3 (Criteria of warning are elaborated in SLPRSD) to discuss by Mr. Sato.

f. Output 4 (Content and accessibility of meteorological information) to improve the web information and to be more user friendly. Dissemination of weather forecast to DRRMO and other concerned government agencies. PAGASA Web pages have found mixed information. Comments and suggestions are shared.

- *Dr. Malano asked the team if they made an assessment considering Project NOAH site for meteorological services, this should be integrated with PAGASA website.*
- *Dr. Malano asked for some justification on how the media raised the awareness of the people yet all the weather information are coming from PAGASA.*
- *Dr. Cayanan asked to elaborate the "mixed" with other information in website, will PAGASA need to separate the website of PAGASA H.O. to PRSD. Mr. Yamamoto explains that upon observation, the website of NCR PRSD are different from Southern Luzon PRSD.*
- *According to Dir. Tabell of DILG, on their observation, PAGASA website is already improved, he suggests that the homepage should show the current information on real time weather updates.*
- *Dr. Malano suggests the team to organise the PAGASA website.*
- *Mr. Yamamoto assured PAGASA that they will improve the website by February and will add more new ideas for improvement of the website with consultation and approval of PAGASA before implementation.*

g. Output 5 (Awareness raising activity). Select a pilot province to assess the situation and to prepare materials for awareness raising activity. This activity also conducted in PAGASA head office and SLPRSD. The team will provide pamphlets, posters for the improvement of educational materials.

- *Dr. Malano inquires the team, if there are activities related to DepEd for the elementary grades school, example of it is pamphlets leaflets and flyers. (comics, etc.)*
- *As per Ms. Yumi, during their previous visit in Southern Luzon, they observed that DepEd need to be provided and to distribute educational materials in schools. Dr. Malano suggests to use a special design for the young ones.*
- *Dr. Cayanan suggests the assessment to launch this through Google global information system for dissemination of public awareness activity.*

V. Mr. Sato reported the updates of Logical Framework (Project Design Matrix: PDM). Mr. Sato also raised some issues during the last JCC and giving an update on each issue.

- *Dr. Malano suggests to include in Project Purpose of OVI as no. 4 "More than 80% of forecasters pass on the use of Numerical Methodology products". Dr. Cayanan also suggests to include the suggestion of Dr. Malano. (for further discussion with JICA)*
- *Dr. Malano suggests to include in Project Purpose of Output 2. In OVI "the capacity building of regional forecaster and for meteorology group with the use of SATAID since JMS provides data of output and how to interpret data from GSM and ABS". (for further discussion on coordination meeting)*
- *Ms. May Ash from NEDA raised some question, regarding capacity building should consider a turn over personnel of PAGASA to induced the knowledge system, the information are stated with the organization (As Dr. Malano, the aspect of turnover of personnel PAGASA will be addressed to the organization of PAGASA, for further discussion)*

VI. Mr. Raymond presented the updated list of counterpart that during the 1st JCC Meeting, it was only presented by Project Director, Project Manager and Coordinator from PAGASA. Currently, PAGASA added the counterpart from different division. And since the project has 5 Outputs, PAGASA in addition presented a creation of Technical Working Group (TWG) to focus on achievement of each output. To name the group as Meteorological Instrument Group, Radar Maintenance Group, SATAID Group, Weather Guidance Group, Web Information Group and Public Awareness Group. QPE on data calibration group will be discussed tomorrow on the Special Seminar.

VII. Quantitative Precipitation Forecast was presented by Mr. Nobuo Sato, Chief Adviser of J-POW Project. The two ways of forecast rainfall are Kinematic and Dynamic. Kinematic is time extrapolation of heavy rainfall area (QPF) and Dynamic is solving the fluid dynamics equations (NWP). The most advanced NWP research carried out 11 Peta Flops computer (K-computer) means 1000 times of computer. Showing an example of the forecast rainfall 18 hours beforehand.

To know the precipitation areas QPE should be carried out and by tracking a heavy precipitation area, QPF was developed. The improvement of accuracy is in reference to the online data of ARG and JMA observation data.

The warning is already issued in every municipality. The QPE and QPF are now used to compute Soil water index and Runoff index; QPE, QPF and SWI are used in warning in landslide; QPE, QPF and Runoff Index used to issue warnings on flooding.

Mr. Sato presented a setting Criteria of Warning/Advisory. The Scattered Diagram easily defines the measurement precipitation of rainfall showing the result of rainfall.

Though K-computer is not enough, Riken is developing Exa Flops computer means 100,000 times of computer in order to predict intense & torrential precipitation. JMA upgrade their computer system every 5 years. Mr. Sato recommends the needs of more observation data, weather data and more automatic rain gauges.

- DILG, Dir. Tabell pledged to donate one(1) ARG to PAGASA.
- As per Dr. Cayanan, the presentation is carried out in the situation in Japan. Dr. Cayanan asked to assess the situation to forecast an hourly or at least linear.
- As per Mr. Sato, PAGASA should use the random observation to AWS to increase the number of ARG database. Time is not too expensive to resolve ARG.
- According to Dr. Malano, Japan has 800mm of rain fall in five days and Philippines have 1000mm of rain fall in one day.
- PAGASA continuously improving their services, planning to assert more facilities the number of observations. Furthermore, there are also private observatory company around. Dr. Malano suggests the other observatory facilities must be integrate with the observation facilities of PAGASA. Although PAGASA has existing 2000 observation facilities.
- For preparation of soil water index, will be provide by JICA Philippine office as per request by Dr. Manalo.
- OCD, requires LGUs on NDRRM post.
- For PAGASA, 187 have some stations installed a river basins
- Project NOAH established more than 1000 river basins
    - 600 AWS
    - 400 ARG
- All are integrated in PAGASA system.

Closing remarks from Dr. Cayanan and assured everyone for more improvement in products and services in the near future as the purpose of this project. Thanking everyone for continued support to PAGASA. Also thank the JICA for the support.

(End of discussion)

Appendix 1: List of participants of JCC meeting
Appendix 2: Hand-outs of JCC meeting

MINUTES OF MEETING
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
PHILIPPINE ATMOSPHERIC, GEOPHYSICAL AND ASTRONOMICAL SERVICES ADMINISTRATION, DEPARTMENT OF SCIENCE AND TECHNOLOGY
ON
PROJECT FOR ENHANCING CAPACITY ON WEATHER OBSERVATION, FORECASTING AND WARNING

Japan International Cooperation Agency (hereinafter referred to as "JICA"), the Philippine Atmospheric, Geophysical and Astronomical Services Administration, The Department of Science and Technology (hereinafter referred to as "PAGASA") and other Philippine authorities concerned have discussed several major issues during the Third Joint Coordinating Committee (hereinafter referred to as "JCC") Meeting for the Project for Enhancing Capacity on Weather Observation, Forecasting and Warning (hereinafter referred to as "J-POW Project") on 9th July 2015 in PAGASA.

Both Philippine and Japanese sides exchanged views with respect to the desirable measures to be taken by the PAGASA and the Project Team (hereinafter referred to as "the Team") for the successful implementation of the Project.

As a result of the discussions, the PAGASA and the Team have agreed on the matters referred in the document attached herewith.

Quezon City, 9th July 2015

Mr. Nobuo Sato
Chief Advisor and Expert on Weather Forecasting/Administration
J-POW Project

Dr. Vicente B. Malano
Acting Administrator
Philippine Atmospheric, Geophysical and Astronomical Services Administration,
Department of Science and Technology

Witness by

Mr. Takahiro Morita
Senior Representative
JICA Philippines Office

Dr. Esperanza O. Cayanan
Chief
Weather Division
Philippine Atmospheric, Geophysical and Astronomical Services Administration,
Department of Science and Technology

Highlights and Discussions of the Meeting

The Team and PAGASA Counterparts made the presentations on "J-POW Project Progress Report" for each output followed by the video presentation named "1st Year Anniversary: J-POW project". The JICA training plan in Japan scheduled in October of 2015 (Appendix1: Agenda of 3rd JCC meeting) was also introduced. After the presentations, the revised Project Design Matrix (hereinafter referred to as "PDM") version 1 was proposed by PAGASA and the revised PDM and other matters regarding the Project were discussed. The main issues presented, discussed and terms agreed are as follows:

1. Revision of PDM

PAGASA proposed revisions of PDM from version-0 to Version-1 as follows:

Activities

1) "2-4 Conduct of experiments on the use of Global Spectral Model (GSM) in Weather Research and Forecasting (WRF)." should be added.

2) The phrase of "and propose list of activities" should be inserted in the statement of 5-4.

Objectively Verifiable Indicators (OVI)

3) 1-1, 1-2, 2-1 and 2-2 are described as practical indicators shown in Appendix 2.

Means of Verification (MV)

4) 1-1, 1-2, 2-1 and 2-2 are described as practical means shown in Appendix 2.

5) The word 'Action Plan' in MV 5-1 and 5-2 should be replaced by 'Program' to cover Output 5 activities properly.

JCC members discussed the proposed PDM as follows:

Major discussion regarding revisions of PDM

1) Activity 2-4

JCC members confirmed and agreed to add Activity 2-4 by giving advices to PAGASA who will conduct experimental runs using WRF model with Japan Meteorological Agency (JMA) GSM as input data.

2) Activity 4-2

PAGASA mentioned the necessity to enhance its mobile application and JCC members agreed that the enhancement of mobile application is included under the existing activity "4-2 Improvement the contents of meteorological information to be more user-friendly".

3) Activity 5-4

JCC members agreed to add the phrase to Activity 5-4 to describe Output 5 activities properly.

M.S.

4) OVIs and MVs

JCC members agreed to revise OVIs and MVs as proposed.

Finally JCC members agreed on the revisions mentioned above and proposed to JICA the revised PDM Version-1. The revisions made on PDM are shown in the table below and the PDM Version-1 and Plan of Operation Version-1 are attached as Appendix 2.

[Revision on PDM]

Revised PDM	PDM version 0
Activities	
2-4 Conduct of experiments on the use of GSM in WRF.	
5-4. Identify challenges and propose list of activities to enhance awareness of local population on weather related disasters.	5-4. Identify challenges to enhance awareness of local population on weather related disasters
OVI	
5-1 Program of awareness-raising is enhanced.	5-1 Action plan of awareness-raising is enhanced.
5-2 Result of the implementation of the program is reported.	5-2 Result of the implementation of action plan is reported.

2. Miscellaneous

1) Radar

PAGASA informed that the communication system via VSAT of Aparri radar has problems due to salty winds and the observed data cannot be sent by via VSAT. PAGASA already reported to the manufacturer of the radar about the situation and requested to take relevant measures. However, the problems have not been solved.

PAGASA also informed that Virac radar has electric power fluctuation which brings frequent use of power generator and may cause severe damage to the radar. PAGASA requested the Team to propose a recommendation plan to protect the radar from such fluctuation. The team informed that they would formulate a set of recommendations for PAGASA.

2) PAGASA Services Handbook

The Team proposed to produce 'PAGASA Services Handbook' to be launched during the "World Meteorological Day" on 23rd March 2017 and asked that an editorial board is to be organized in July to August of 2015. PAGASA recommended including the Congress as one of the stakeholders. JCC agreed to the above proposal and recommendation.

(End of meeting)

Appendixes:

1. Agenda of 3rd JCC meeting
2. PDM Version-1 and Plan of Operation Version-1

N.S

3rd Joint Coordination Committee (JCC) Meeting for J-POW PROJECT

(JICA Project for Enhancing Capacity on Weather Observation, Forecasting and Warning)

Amihan Conference Room, Science Garden, PAGASA
9:00 AM - 12:00 PM on 9th July 2015

Agenda

08:30 AM	**Registration**
09:00 - 09:20 AM	
Welcome Remarks:	**Dr. Vicente B. Malano** Acting Administrator, PAGASA and Project Director, J-POW
Opening Message:	**Mr. Takahiro Morita** Senior Representative, JICA Philippine Office
09:20 - 09:30 AM	**"1st Year Anniversary: J-POW Project"**
09:30 - 10:45 AM	**"J-POW Project Progress Report"**
	Weather Observation (Output-1), Meteorological Data Analysis (Output-2a) and Meteorological Information (Output-4) **Mr. Michihiko Tonouchi** Deputy Leader, Technical Expert Team, J-POW Project
	Weather Guidance (Output-2b) **Dr. Masao Mikami** Deputy Leader, Technical Expert Team, Japan Meteorological Business Support Center **Mr. Raymond C. Ordinario** Weather Specialist I, Weather Division, PAGASA
	Warning Criteria (Output-3) **Mr. Nobuo Sato** Chief Advisor and Expert on Weather Forecasting/Weather Administration, J-POW Project
	"SL-PRSD's Heavy Rainfall Warning System" (Output-3) **Ms. Lilian N. Guillermo** Senior Weather Specialist, SL-PRSD, PAGASA
	Awareness Raising Activities (Output-5) **Dr. Masao Mikami**
	JICA Training in Japan **Mr. Ryusuke Taira** Expert on Weather Guidance, J-POW Project
	J-POW Project PR **Yumi Schultz** Project Coordinator/ Public Relations Specialist, J-POW Project
10:45 - 11:00 AM	**Break**
11:00 - 11:15 AM	**"Presentation of the Revised Project Design Matrix (PDM) "** **Dr. ESPERANZA O. CAYANAN**
11:15 - 11:50 AM	**Open Forum**
11:50 - 12:00 NN	**Dr. ESPERANZA O. CAYANAN**
Closing Remarks	Chief, Weather Division, PAGASA and Project Manager, J-POW
12:00 NN-	**Lunch**

*Contact: Project Management Office in PAGASA Tel: (02) 433-1020

Logical Framework (Project Design Matrix: PDM) (Version-1)

Project title: Project for Enhancing Capacity on Weather Observation, Forecasting and Warning
Project period: Three years (2014 – 2016)
Target group: PAGASA[1] Central Office; Southern Luzon PRSD[2] (as pilot) and other PRSDs (as non-pilot); Three Meteorological Radar Observation Stations (Virac/ Apari/ Guiuan); and LGUs[3]
Target area: Operation areas of Southern Luzon PRSD (direct target); the whole country (indirect target)

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Super Goal: Weather related disaster is mitigated.			
Overall Goal: Capacity of all PRSDs is enhanced in terms of weather observation, forecasting and warning.	1. More than 80% of LGUs in non-pilot PRSDs agree that laymanized meteorological information is timely delivered to them.	Results of questionnaires to concerned actors	
Project Purpose: Capacity of PAGASA Central Office and Southern Luzon PRSD is enhanced in terms of weather observation, forecasting and warning.	1. Average operation rate (i.e. data are provided to PAGASA from radars) of three radars becomes more than 80% in the third year. 2. Quantitative forecasting is issued by using weather guidance. 3. More than 80% of concerned actors (i.e. OCD[4]; PCG[5]; LGUs in pilot PRSD) agree that laymanized meteorological information is timely delivered to them in the third year.	Data record at Central Office Issued forecast Results of questionnaires to concerned actors	Government policy on PAGASA's mandate is unchanged.
Output 1: Capacity on weather observation is improved.	1-1 Traceability of Instrument is improved through development of reference guides regarding maintenance and calibration. 1-2 Capability of more than 80% of staff engaged in the maintenance and calibration of SYNOP/ AWS[6] stations and radar stations is enhanced. 1-3 Maintenance reports on respective equipment (i.e. radars, synop stations and AWS) are regularly prepared and reported to the PAGASA Central Office.	Instrument traceability record. Result of pre and post training evaluation conducted by the project Maintenance reports	
Output 2: Capacity on meteorological data analysis and forecasting is improved.	2-1 Capability of 80% of the operational staff on the use of SATAID[7] is improved. 2-2 Software for radar data calibration with rain gage data is developed. 2-3 Weather guidance is developed.	Pre and post training evaluation is conducted. Development of RADAR-AWS software. Weather guidance	

Appendix 2

Output 3: Criteria of warnings are elaborated at Southern Luzon PRSD.	3-1 Criteria of warnings are made at the provincial level.	Criteria of warnings	
Output 4: Content and accessibility of meteorological information are improved.	4-1 Laymanized and professional information are differentiated at PAGASA's website. 4-2 Meteorological information is timely transmitted by PAGASA Central Office to concerned agencies particularly DRRMC[8]	PAGASA's website Record on information transmission	
Output 5: Activities of awareness-raising on meteorological information are improved at Southern Luzon PRSD.	5-1 Program of awareness-raising is enhanced. 5-2 Result of the implementation of the program is reported.	Program plan Program reports	

Activities	Inputs		
	Japan side	Philippines side	Trained staff remain working at concerned stations and offices.
1.1 Monitor the operation of newly introduced three radars and identify issues in their operations. 1.2 Provide trainings for obtaining quality data from three radars including maintenance of facilities and equipment. 1.3 Develop a guideline and provide training on quality control of radar data. 1.4 Identify current status and issues on maintenance of AWS and Synop observatory at the Southern Luzon pilot PRSD. 1.5 Develop manuals and plans for calibration and maintenance, and inspection guideline of AWS and Synop observatory at Southern Luzon PRSD. 1.6 Provide training on calibration and maintenance based on the above plans at Central Office and Southern Luzon PRSD. 2.1 Provide training on the operation of SATAID. 2.2 Develop software and provide training on methods to correct radar data by using surface observation data. 2.3 Provide training on weather guidance (MOS)[9]. 2.4 Conduct of experiments on then use of GSM[10] in WRF[11]. 3.1 Conduct survey on current situation of warning and identify their challenges. 3.2 Elaborate methods to improve warnings and make criteria of warnings based on the above findings. 4.1 Identify challenges on the content of meteorological information. 4.2 Improve the content of meteorological information to be more user-friendly. 4.3 Improve ways of information dissemination to the concerned agencies particularly DRRMC.	1. Experts ・ Chief Advisor/ Weather Forecasting ・ Surface Meteorological Observation ・ Radar Data Analysis ・ SATAID / Satellite Image Analysis ・ Meteorological Observation Technology ・ Weather Guidance ・ Operation and Maintenance of Radar ・ Weather Information / Information Technology ・ Weather Disaster Awareness Raising ・ Project Coordinator 2. Training in Japan 3. Equipment ・ Desktop Computer(s) ・ Printer(s) ・ Projector ・ Screen ・ Equipment related to training 4. Expenses Expenses necessary for the implementation of the Project	1. Counterpart personnel ・ Project Director ・ Project Manager ・ Assistant Project Manager ・ Staff from Weather Division, PAGASA ・ Staff from Engineering and Technical Services Division, PAGASA ・ Staff from Research & Development and Training Division, PAGASA ・ Staff from Southern Luzon PRSD, PAGASA ・ Staff from National Capital Region PRSD, PAGASA 2. Project office and facilities 3. Expenses Running expenses necessary for the implementation of the Project	Preconditions N/A

4.4 Improve the content of website at Central Office and Southern Luzon PRSD. 5.1 Select pilot province(s) for awareness raising activities. 5.2 Assess local situation on the use of meteorological information. 5.3 Analyze causes of weather related disasters. 5.4 Identify challenges and propose list of activities to enhance awareness of local population on weather related disasters. 5.5 Prepare materials for awareness raising activities. 5.6 Conduct awareness raising activities and collect local feedback on awareness raising activities.			

Remark: 1. Philippine Atmospheric, Geophysical and Astronomical Services Administration, 2. PAGASA Regional Services Division, 3. Local Government Unit, 4.Office of Civil Defense, 5. Philippines Coast Guard, 6. SYNOP: Surface Synoptic Observations and AWS: Automatic Weather Station, 7. Satellite Animation and Interactive Diagnosis, 8. Disaster Risk Reduction Management Committee, 9. Model Output Statistics, 10. Global Spectral Model, 11. Weather Research and Forecasting.

Plan of Operation (Version-1)

	1st Year				2nd Year				3rd Year			
	MJJ	ASO	NDJ	FMA	MJJ	ASO	NDJ	FMA	MJJ	ASO	NDJ	FMA
Output 1: Capacity on weather observation is improved.												
1.1 Monitor the operation of newly introduced three radars and identify issues in their operations.	■											
1.2 Provide training on maintenance for obtaining quality data from three radars.		■	■				■		■			
1.3 Develop a guideline and provide training on quality control of radar data.		■	■				■					
1.4 Identify current status and issues on maintenance of AWS and Synop observatory at Southern Luzon PRSD.	■	■										
1.5 Develop manuals and plans for calibration and maintenance, and inspection guideline of AWS and Synop observatory at Southern Luzon PRSD.		■			■		■			■		
1.6 Provide training on calibration and maintenance based on the above plans at the Central Office and Southern Luzon PRSD.			■			■			■		■	■
Output 2: Capacity on meteorological data analysis and forecasting is improved.												
2.1 Provide technical training on the operation of SATAID.		■					■		■			
2.2 Develop software and provide training on methods to correct radar data by using surface observation data.		■			■			■			■	
2.3 Provide training on weather guidance (Model Output Statistics).		■		■		■		■				
2.4 Conduct of experiments on then use of GSM in WRF.								■	■	■		
Output 3: Criteria of warnings are elaborated at Southern Luzon PRSD.												
3.1 Conduct survey on current situation of warning and identify their challenges.	■											
3.2 Elaborate methods to improve warnings and make criteria of warnings based on the above findings.		■				■			■	■		
Output 4: Content and accessibility of meteorological information are improved.												
4.1 Identify challenges on the content of meteorological information.	■	■										
4.2 Improve the content of meteorological information to be more user-friendly.		■		■		■	■	■				
4.3 Improve ways of information dissemination to the concerned agencies particularly DRRMC.			■		■					■		
4.4 Improve the content of website at the Central Office and Southern Luzon PRSD.			■			■	■	■	■		■	■
Output 5: Activities of awareness-raising on meteorological information are improved at Southern Luzon PRSD.												
5.1 Select pilot province(s) for awareness raising activities.	■	■										
5.2 Assess local situation on the use of meteorological information.	■	■				■			■	■		
5.3 Analyze causes of weather related disasters.			■	■	■		■		■			
5.4 Identify challenges and propose list of activities to enhance awareness of local population on weather related disasters.	■			■		■			■	■		
5.5 Prepare materials for awareness raising activities.		■		■		■		■				
5.6 Conduct awareness raising activities and collect local feedback on awareness raising activities.		■		■		■		■		■		

MINUTES OF MEETING
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
PHILIPPINE ATMOSPHERIC, GEOPHYSICAL
AND ASTRONOMICAL SERVICES ADMINISTRATION,
DEPARTMENT OF SCIENCE AND TECHNOLOGY
ON
PROJECT FOR ENHANCING CAPACITY ON WEATHER OBSERVATION, FORECASTING AND WARNING

Japan International Cooperation Agency (hereinafter referred to as "JICA"), the Philippine Atmospheric, Geophysical and Astronomical Services Administration, The Department of Science and Technology (hereinafter referred to as "PAGASA") and other Philippine authorities concerned have discussed several major issues during the Fourth Joint Coordination Committee (hereinafter referred to as "JCC") Meeting for the Project for Enhancing Capacity on Weather Observation, Forecasting and Warning (hereinafter referred to as "J-POW Project") on 28th January 2016 at SEAMEO Innotech in Quezon city.

Both Philippine and Japanese sides exchanged views with respect to the desirable measures to be taken by the PAGASA and the Project Team (hereinafter referred to as "the Team") for the successful implementation of the Project.

As a result of the discussions, the PAGASA and the Team have agreed on the matters referred in the document attached herewith.

Quezon City, 28th January 2016

佐藤信夫

Mr. Nobuo Sato
Chief Advisor and Expert on Weather Forecasting/Administration
J-POW Project

Dr. Vicente B. Malano
Acting Administrator,
Philippine Atmospheric, Geophysical and Astronomical Services Administration,
Department of Science and Technology

Witness by

森田隆司

Mr. Takahiro Morita
Senior Representative
JICA Philippines Office

Highlights and Discussions of the Meeting

The Team and PAGASA Counterparts made the presentations on "J-POW Project Progress Report" for each output. The "Highlights and Businesses Arising from Previous JCC meeting" and "Training held in Japan (Appendix1: Agenda of 4th JCC meeting) were also introduced. The main issues presented, discussed and terms agreed are as follows:

1, Highlights

[This section is duplicated, should be delete?]

J--POW final goal is to enhance capacity on weather observation, forecasting and warning in the Philippines. For this purpose, J-POW project has started since May 2014 with 7 sub-teams from Output-1a to Output 5, which aim the activities on Radar Maintenance (O-1a), Surface Observation (O-1b), SATAID (O2-a), Guidance (O-2b), Warning Criteria (O-3), Weather Information (O-4), and Awareness Raising (O-5), respectively. From the end of June 2015, each WGs stepped up their activities from Survey Phase to Implementation Phase. Until the end of 2015, J-POW has carried out various activities for improving traceability of instrument and for better operation and observation quality of Radars. Lectures and trainings for weather guidance were also practiced intensively for developing operational temperature forecast. For introducing warning criteria at the provincial level, lectures and discussion on the warning criteria were done. For dissemination of more user-friendly information, mobile phone app has been developed. And for raising awareness on severe weather and decreasing disaster risk, practice on seminar at elementary schools and broadcast of radio clips has been carried out, too.

1) Output-1a (Radar Maintenance)

Regular basic maintenance and ~~regular~~ performance check is being implemented by PAGASA at Aparri. However, reports for trouble shooting or repair are not enough.

In order to step up maintenance in higher level, the senior radar engineer training is scheduled at Virac from 15th February to 11th March 2016.

The configuration of observation angles for PAGASA radar should be discussed in order to eliminate ground/sea clutters as well as to enable rainfall observation near the radar site.

2) Output-1b (Weather Observation)

In 2015, based on the results of baseline inspection (low accuracy of calibration equipment, traceability not secured, and instrumental error), Working Group (WG) members visited more than 18 sites and made verification on the precision/accuracy of the indicated values of operational barometers used in the station. Proper observation procedures and accuracy of the weather report are expected to be secured through training, practice and lectures by J-POW project. Also standard barometer sets were handed over for use in calibration and inter-comparison of barograph at stations. 3 JMA short term experts exchange knowledge and inter-comparison for traceability of instruments in early March.

3) Output-2a (Meteorological Data Analysis)

PAGASA already uses satellite data and SATAID, however, satellite analysis is not enough due to the emergence of the new 'HIMAWARI8/9 products'., , The satellite analysis training on 'SATAID usage for new satellite' and 'Dvorac method 'is scheduled from 15th to 19th February 2016.

Radar product team is trying to make calibrated radar data with rain gauges data, however, enough data for the analysis is not collected. The team plans to install Southern Luzon Rain Gauge Network for gathering additional rain gauge data and calibrate radar data with rain gauge data.

4) Output-2b (Weather Guidance)

The activities of Technical Working Group on weather guidance were reported. The results of their experiments showed the good potential of weather guidance for the improvement of the accuracy of operational forecast of PAGASA.

The plan of operational use of the guidance in the forecast work was also reported.

5) Output-3 (Warning Criteria)

In order to build a warning criteria at the provincial level, review on severe weather bulletin (PSWS), storm watch, and activities in the target provinces was done. Based on this inspection,

training and lectures on precipitation forecast system in JMA and discussion on the importance of calibration of radar images by rain gauge network data were carried out. Finally, discussion and consulting on warning criteria in SLPRSD and examination of usage of rain gauge data for warning criteria were also carried out.

[Alternative summary for OUTPUT3 presentation suggested by Sato-san]
Consultation Meeting on Disaster Risk Reduction (DRR) were conducted at Albay, Northern Samar and Sorsogon by PAGASA and provincial/city/municipality DRR management Offices (DRRMOs). They conduct exercises and awareness activities against natural hazards and make up hazard maps. PAGASA issued severe weather bulletins, description on strong wind is mentioned, however, description on accumulated rainfall relates to landslide and flood is not enough. The rainfall forecast should be reported depending on Numerical Weather Prediction (NWP) and in regards to NWP improvement we have to ask for the international community.

6) Output-4 (Meteorological Information)
In order to improve the content of meteorological information to be more user-friendly and ways of information dissemination to the concerned agencies particularly DRRMC, the following activities have been done; J-POW project team surveyed the requirements and challenges of users, designed apps for mobile device, built Website for mobile device, and provided Google Analytics training to WG members.

7) Output-5 (Awareness Rising Activities)
A set of educational materials that help pupils to learn weather-related disasters as well as radio clips for the general public have been developed. In August 2015, two pre-test awareness seminars were held at elementary schools located in the capitals of pilot provinces. In November 2015, the 1st series of awareness seminars were held at four elementary schools located in the pilot provinces.
Radio clips on "Bagyo" and storm surge were broadcasted in the target areas for a week around the time of the 1st awareness seminars.

8) Training held in Japan
(Meteorological Training Course, held Sep.14 – Dec.12) were reported by the participant. A PAGASA staff attended this training.
The contents and results of JICA's Weather Forecasting Training (The training in Japan of J-POW project, held Oct.12 – Oct.24) were also reported by the participant. 4 members of PAGASA staff attended this training.

2. Discussions

1) Output-1a (Radar Maintenance)
PAGASA understands commercial electricity power problems and already started negotiation with electric companies to fix problems. The Team informed the rusty door joints problem at Virac and Aparri to PAGASA. PAGASA responded to address the problems.
The 'Senior Radar Engineers training' for 4 weeks in Virac by Mr. Wakabayashi is scheduled from 15th February to 11th March 2016.

2) Output-1b (Weather Observation)
PAGASA intends to change from mercurial barometers to digital barometers due to UNEP Minimata Convention which is about the banning of the use of mercury to take effect by 2020. The change is also based on the "Commission for Instruments and Methods of Observation (hereinafter referred to as "CIMO") - Sixteenth session: Abridged final report with resolutions and recommendations" reported by CIMO in 2014. Calibration policies for digital barometers will be required.

PAGASA inquired how often calibration should be implemented and the Team informed that every 5 years the calibration of regional and national standards with international standards is recommended by means of travelling standards as suggested from the CIMO Guide, "Guide to Meteorological Instruments and Methods of Observation", and synoptic stations should be inspected once every 1 year or no less than once every two years. The calibration may also depend

on the recommendation of manufacturers. The barometer calibration policy should be discussed between Regional Instrument Center (hereinafter referred to as "RIC") Manila and RIC Tsukuba during RIC Tsukuba short term training scheduled in March 2016, and PAGASA and the Team agreed to have discussion in the training.

The Team found there exist differences between observed barograph value from PAGASA and analyzed typhoon pressure around typhoon center. The difference was pointed out by Japan Meteorological Agency (JMA). PAGASA also pointed out that observation by mercury barometer is correctly implemented. PAGASA and the Team should make it clear why such differences exist and its reason. PAGASA requested the Team to report this matter during the training in March 2016. The training will be on the 'Calibration and Equipment Maintenance' for 3 days in Quezon city and survey at Southern Luzon PRSD by RIC Tsukuba and JMA experts. The training is scheduled from 7th to 15th of March 2016.

3) Output-2a (Meteorological Data Analysis)
A training on 'Satellite Analysis' for 1 week in Quezon by JMA 3 experts is scheduled from 15th to 19th of February 2016.

4) Output-2b (Weather Guidance)
PAGASA requested development and trial for wind guidance. The team explained that the Team develops operational temperature guidance by Kalman Filter at first then tries to develop precipitation guidance. The Project aims at technical skill transfer for making guidance. Technical Working Group of Weather Guidance would be able to develop various element guidance which meet the PAGASA's operational requirements after the initial technical transfer ended.

5) Output-2a and 3 (Warning Criteria)
The Team proposed an installation of "South Luzon Rain Gauge Network" for developing Quantitative Precipitation Estimation and warning criteria activity. PAGASA and the Team agreed with the plan. However, JICA noted when Japanese visit Masbate a security briefing by the Japanese Embassy should be a requirement.

6) Output-4 (Meteorological Information)
PAGASA suggested that the mobile phone application and information should be developed not only for National Capital Region and South Luzon PRSD but also for other areas. The other contents such as weather information for tourists should be developed in the future.

7) Output-5 (Awareness Rising Activities)
The Department of Education (DepEd) pointed out that the material should be shared to 17 regions and 331 divisions' coordinators through coordinator trainings. PAGASA agreed to send staff members to the coordinator trainings based on the official request from the DepEd.

2. Miscellaneous

JICA informed that there is one trainee seat for JICA training course 'Meteorology' in 2016 Autumn.
PAGASA executives will be visiting JMA and its facilities from 1st to 5th of February 2016 to study JMA weather services.

(End of meeting)

Appendixes:
1. Agenda of 4rd JCC meeting

4th Joint Coordination Committee (JCC) Meeting for J-POW PROJECT

(JICA Project for Enhancing Capacity on Weather Observation, Forecasting and Warning)

SEAMEO Innotech, Regional Headquarter, Commonwealth Avenue, Diliman Quezon City

28th January 2016; 8:30 AM to 12:00 PM

Agenda

I. Call to Order	**Dr. Vicente B. Malano** Acting Administrator, PAGASA Project Director, J-POW Project
II. Statement	**Mr. Takahiro Morita** Senior Representative, JICA Philippines Office
III. Highlights and Business Arising from previous JCC	**Dr. Esperanza O. Cayanan** Chief, Weather Division, PAGASA Project Manager, J-POW Project
IV. Project Progress Reports	
a) Radar Maintenance (Output-1a) b) Meteorological Data Analysis (Output-2a) c) Meteorological Information (Output-4)	**Mr. Michihiko Tonouchi** Team Leader, J-POW Project
d) Weather Observation (Output-1b)	**Mr. Koji Matsubara** Expert, J-POW Project **Mr. Ferdinand Barcenas** * OIC, IRDU, PAGASA
e) Weather Guidance (Output-2b)	**Mr. Ryusuke Tiara** Expert, J-POW Project **Mr. Raymond Ordinario** * Weather Specialist I, WD, PAGASA
f) Warning Criteria (Output-3)	**Mr. Nobuo Sato** Chief Advisor, J-POW Project
g) Awareness Raising Activities (Output-5) h) J-POW Project current achievements and expected outcome	**Dr. Masao Mikami** Deputy Team Leader, J-POW project
V. Other activities: Training held in Japan	**Dr. Esperanza O. Cayanan**
VI. Other matters	
VII. Concluding remarks and adjournment	**Dr. Vicente B. Malano**

* Presenter

MINUTES OF MEETING
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
PHILIPPINE ATMOSPHERIC, GEOPHYSICAL
AND ASTRONOMICAL SERVICES ADMINISTRATION,
DEPARTMENT OF SCIENCE AND TECHNOLOGY
ON
PROJECT FOR ENHANCING THE CAPACITY ON WEATHER OBSERVATION, FORECASTING AND WARNING

Japan International Cooperation Agency (hereinafter referred to as "JICA"), the Philippine Atmospheric, Geophysical and Astronomical Services Administration, The Department of Science and Technology (hereinafter referred to as "PAGASA") and other Philippine authorities concerned have discussed several major issues during the Fifth Joint Coordination Committee (hereinafter referred to as "JCC") Meeting for the Project for Enhancing the Capacity on Weather Observation, Forecasting and Warning (hereinafter referred to as "J-POW Project") on 7th June 2016 at SEAMEO Innotech in Quezon city.

Both Philippine and Japanese sides exchanged views with respect to the desirable measures to be taken by the PAGASA and the Project Team (hereinafter referred to as "the Team") for the successful implementation of the Project.

As a result of the discussions, the PAGASA and the Team have agreed on the matters referred in the document attached herewith.

Quezon City, 7th June 2016

左藤信夫

Mr. Nobuo Sato
Chief Advisor and Expert on Weather Forecasting/Administration
J-POW Project

Dr. Vicente B. Malano
Acting Administrator,
Philippine Atmospheric, Geophysical and Astronomical Services Administration,
Department of Science and Technology

Witness by

森田隆則

Mr. Takahiro Morita
Senior Representative
JICA Philippines Office

Highlights and Discussions of the Meeting

The Team and PAGASA Counterparts made the presentations on "J-POW Project Progress Report" for each output. The "Highlights and Businesses Arising from Previous JCC meeting" and "Training held in Southern Luzon and Central office" (Appendix1: Agenda of 5th JCC meeting) were also introduced. The main issues presented, discussed and terms agreed are as follows:

1, Highlights

1) Output-1a (Radar Maintenance)
Regular fundamental maintenance and performance check is being implemented by PAGASA at Aparri. However, reports for trouble shooting or repair are not enough.
In order to step up to higher-level maintenance, the senior radar engineer training is scheduled at Virac from 15th February to 11th March 2016.
PPI elevation should be discussed for quantitative observation nearby RADAR site considering PAGASA RADAR observation concepts with RADAR staff, product research team, users and administrators.

2) Output-1b (Weather Observation)
In 2015, based on the results of baseline inspection (issues on resolution of calibration equipment, traceability not secured, and instrumental error), Working Group (WG) members visited more than 18 sites and made verification on the precision/accuracy of the indicated values of operational barometers used in the station. Proper observation procedures and accuracy of the weather report were secured through training, practice and lectures by J-POW project. Also standard barometer sets were hand over for use in calibration and intercomparison of barograph at stations.

3) Output-2a (Meteorological Data Analysis)
PAGASA already uses satellite data and SATAID, however, satellite analysis is not enough due to the emergence of the new 'HIMAWARI8/9 products'., , The satellite analysis training on 'SATAID usage for new satellite' and 'Dvorac method' is scheduled from 15th to 19th February 2016.
Radar product team is trying to make calibrated radar data with rain gauges data, however, enough data for the analysis is not collected. The team plans to gather additional rain gauge data and continuously collect radar and rain gauge data for Southern Luzon Rain Gauge Network

4) Output-2b (Weather Guidance)
The activities of Technical Working Group of Weather guidance were reported. The results of their experiments on the temperature forecast showed the good potential of weather guidance for the improvement of the accuracy of operational forecast of PAGASA.
The plan of operational use of the guidance in the forecast work was also reported.

5) Output-3 (Warning Criteria)
In order to build a warning criteria at the provincial level, review on severe weather bulletin, tropical cyclone warning system, and activities in the target provinces was done. Based on this inspection, training and lectures on precipitation forecast system in JMA and discussion on the importance of calibration of radar images by rain gauge network data were carried out. Finally, discussion and consulting on warning criteria in SLPRSD and examination of usage of rain gauge data for warning criteria were also carried out.

6) Output-4 (Meteorological Information)
In order to improve the content of meteorological information to be more user-friendly and find ways of information dissemination to the concerned agencies particularly DRRMC, the following activities have been done; J-POW project team surveyed the requirements and challenges of users, designed apps for mobile device, built Website for mobile device, and provided Google Analytics training to WG members.

7) Output-5 (Awareness Rising Activities)
A set of educational materials that helps pupils to learn weather-related disasters as well as radio clips for the general public have been developed. In August 2015, two pre-test awareness seminars were held at elementary schools located in capitals of pilot provinces. In November 2015, the 1st series of awareness seminars were held at four elementary schools located in the pilot provinces. Radio clips on "Bagyo" and storm surge were broadcasted in the target areas for a week around the time of the 1st awareness seminars.

8) J-POW Project current achievements and expected outcome
J-POW final goal is to enhance the capacity on weather observation, forecasting and warning in the Philippines. For this purpose, J-POW project has started since May 2014 with 7 sub-teams from Output-1a to Output 5, which aim the activities on Radar Maintenance (O-1a), Surface Observation (O-1b), SATAID (O2-a), Guidance (O-2b), Warning Criteria (O-3), Weather Information (O-4), and Awareness Raising (O-5), respectively. From the end of June 2015, each WGs step up their activities from Inspection Phase to Practice Phase. Until the end of 2015, J-POW has carried out various activities for improving traceability of instrument and for better operation and observation quality of Radars. Trainings for weather guidance for automated production system and (QC) quality control function also practiced intensively for developing operational temperature forecast. For enhancing warning criteria a 9 Automated Rain Gauge Network will be installed in Southern Luzon for radar data calibration. For meteorological information, mobile apps were developed and are ready for public use. And for raising awareness preparation for logistics materials for the next awareness and preparedness seminar. For enhancing capacity on weather observation, forecasting and warning, the working group focus on the following: (O-1a) Radar senior engineer training, follow up training and review of training, (O-1b) 3 short term experts implement exchange knowledge and intercomparison for traceability of instruments, 3 short term experts implement lectures and exercised training on HIMAWARI9, (O-2a) SATAID and Dvorak Method, (O-2b) develop operational temperature forecast production system of weather guidance, Building a rain-gauge network to link with radar data for reliable rainfall distribution for warning, (O-4) develop a mobile app for meteorological information and warning for a public, and prepare new materials at SLPRSD joint school exercise and media extend this package to another PRSD.

9) Training held in Southern Luzon and Central Office
a) Radar Operation and Maintenance, held in Virac Feb. 15 – March 11; Hold the same training in the 3 radar sites namely Virac, Aparri and Guiuan on May 23 to June 9.
b) Meteorological Equipment Calibration Traceability and Calibration conducted by RIC Tsukuba, March 10-12.
c) SATAID Training conducted by 3 JMA Expert held Feb. 15-19.

2. Discussions

The team made the presentations on "Current Status of J-POW project" with subsequent supplementary explanation and suggestions by PAGASA and JICA participants. The main points of each output are as follows:

a) **Output 1a**: Radar maintenance - PAGASA recognizes the difficulty to address problem on commercial power and the poor load at the station; and PAGASA will seek advice with JRC to fully optimize the use of radar low power input and the threshold of poor regulator.

b) **Output 2a**: Radar software and training - the team reported that the OJT at 3 radar sites namely Virac, Aparri and Guiuan were conducted and on-going, and also noted that the comparison between radar and AWS data, and radar calibration software would be completely developed by the end of June. The PAGASA reported that JRC replied to the queries about defects of Virac radar except the clutter observed at the monitoring system.
Satellite analysis and training - The team reported effectiveness of training on HIMAWARI-8/9, SATAID and Dvorak technique conducted by 3 experts from JMA based on the results of examinations conducted before and after the training.

c) **Output 1b**: Weather observation - the team stressed importance of instrument traceability related to calibration and maintenance with examples of well-maintained and contrary stations, and reported that development of the manuals/guidelines would be completed before long. Furthermore the use of field note (book) at Legaspi station on a trial basis was introduced. It is expected to improve the methods of observation.

d) **Output-2b:** Weather Guidance - PAGASA is keen to make the weather guidance output be included in the daily forecast operation. In this context, the Working Group should include appropriate forecaster(s) during the internal test of an automated production system towards temporary operation. Dr. Malano will follow-up on the application of Weather Guidance implementation.

e) **Output 3:** Criteria of warnings and QPE – The team reported that the Automatic Rain Gauge (ARG) network in Southern Luzon and Northern Samar would be implemented by the end of July. In addition to existing 5 ARGs in SL PRSD, the new 9 ARGs will be used for radar data calibration. Furthermore the team stressed the necessity to access rainfall observation data on a real-time basis and accordingly suggested to purchase a modem and a PC to archive and visualize the new 9 ARGs for improving warning operation. JICA replied that the purchase of such a modem and a PC should address to JICA HQ and then the team will see if the JICA Philippines office can facilitate this request.

f) **Output 4**: Content and accessibility of meteorological information - The team realized the need for mobile phone accessibility of weather information through the survey of existing PAGASA website and developed a mobile application and website for mobile access. JCC participants were informed that the mobile application under Android on beta version had already been available through Google play store and that the mobile website had been accessible through http://**m.pagasa.dost.gov.ph/weather**. In addition to the initial content mainly on weather it is expected to include other PAGASA information such as climate, flood and so on. Flyers to introduce these services will be distributed to public users.

g) **Output 5:** Awareness Raising Activity – The 1st Awareness Raising Seminar had been carried out in Nov. 2015 with participation of 200 pupils and 159 observers at four schools in Northern Samar and Sorsogon Provinces. Furthermore the team noted the effective

dissemination of weather information as a radio clip and educational materials such as presentation slides, small posters and experiment equipment of "cloud formation".
JCC participants were informed of the next activity plan by the 3rd quarter of this year with a team "Floods" and the educational materials would be shared to DepEd and PAGASA.
DepEd requested for a copy of the presentation used in Awareness Raising Activity. Dr. Cayanan confirmed that the presentation would be shared to them.
NEDA inquired if the Awareness Raising Activity would be intended only for Grade 5 & 6 students and would conduct only at schools. The team showed its plan to conduct in other institutions.

3. Miscellaneous

I. Revision of Counterpart List

Dr. Cayanan presented the updated Counterpart List (Annex to this MM).

Dr. Dalida and Dr. Cayanan stressed the necessity of reducing disaster risks and damages, especially tropical cyclone damages. In this context PAGASA inquired the possibility of having an expert to conduct training on analysis of tropical cyclone and wind pressure estimation. The team replied that they should try to contact JMA HQ for the possibility of this inquiry, because there must be opportunities such as participation in workshops and training with extended stay.

II. Terminal Evaluation

Mr. Nakamura, Project Formulation Advisor of JICA Philippines Office, explained an outline of Terminal evaluation tentatively scheduled from Sept. 29 to Oct. 18. Evaluators will be a consultant appointed by JICA HQ, a JICA official and a JICA advisor from Japanese side, an officials of NEDA and DOST and a PAGASA officer who are not directly involved in the project.

III. Concluding remarks and adjournment

Dr. Dalida expressed his gratitude for participation and cooperation to all attendees of the 5th JCC meeting, especially from the government agencies from NEDA, DepEd and CAAP.

(End of Meeting)

Appendixes:
1. Agenda of 5th JCC meeting
2. Revised Counterpart List

5th Joint Coordination Committee (JCC) Meeting for J-POW PROJECT

(JICA Project for Enhancing Capacity on Weather Observation, Forecasting and Warning)

SEAMEO Innotech, Regional Headquarter, Commonwealth Avenue, Diliman Quezon City

7th June 2016; 8:30 AM to 12:00 PM

Agenda

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II. Statement	**Mr. Takahiro Morita** Senior Representative, JICA Philippines Office
III. Highlights and Business Arising from previous JCC	**Dr. Esperanza O. Cayanan** Chief, Weather Division, PAGASA Project Manager, J-POW Project
IV. Project Progress Reports	
a) Radar Maintenance (Output-1a) b) Meteorological Data Analysis (Output-2a)	**Mr. Michihiko Tonouchi*** Team Leader, J-POW Project **Mr. Fulgencio A. Austria, Jr.** Weather Facilities Specialist II, ETSD, PAGASA
c) Weather Observation (Output-1b)	**Mr. Koji Matsubara** Expert, J-POW Project
d) Weather Guidance (Output-2b)	**Mr. Ryusuke Tiara** Expert, J-POW Project **Mr. Raymond Ordinario*** Weather Specialist I, WD, PAGASA
e) Rain Gauge Network in Southern Luzon	**Dr. Masao Mikami** Deputy Team Leader, J-POW Project
f) Warning Criteria (Output-3)	**Mr. Nobuo Sato** Chief Advisor, J-POW Project
g) Meteorological Information (Output-4)	**Mr. Koji Mitsuhashi*** Expert, J-POW Project **Ms. Samantha Christine V. Monfero** Senior Weather Specialist, WD, PAGASA
h) Awareness Raising Activities (Output-5)	**Dr. Masao Mikami** **Ms. Venus Valdemoro*** Administrative Officer V, RDTD, PAGASA
V. Revision of Counterpart List	**Dr. Esperanza O. Cayanan**
VI. Terminal Evaluation	**Mr. Hayato Nakamura** Project Formulation Advisor JICA Philippines Office
VII. Concluding remarks and adjournment	**Dr. Landrico U. Dalida** Acting Deputy Administrator for O&S, PAGASA

Emcee: Ms. Angelina S. Galang, Weather Specialist I, Office of the Administrator, PAGASA

*Presenter

J-POW Project Overview

(JICA Project for Enhancing Capacity on Weather Observation, Forecasting and Warning)

Project Purpose

Capacity of PAGASA Central Office and Southern Luzon PAGASA Regional Services Division (PRSD) is enhanced in terms of weather observation, forecasting and warning.

Project Outputs

1, Capacity on weather observation is improved.
2, Capacity on meteorological data analysis and forecasting is improved.
3, Criteria of warnings are elaborated at Southern Luzon PRSD.
4, Content and accessibility of meteorological information are improved.
5, Activities of awareness-raising on meteorological information are improved at Southern Luzon PRSD.

Project Term

May 2014 – May 2017 (3 years)

Target Area

Main Target: NCR (National Capital Region) and Southern Luzon PRSD
Sub Target: Whole Nation

Main Activities

Instrument calibration and maintenance training
Radar maintenance training (Virac, Aparri and Guiuan)
Radar data quality control training
Training on radar data calibration against rain gauge data
Satellite image analysis training
Weather guidance training
Production of training manuals & guidelines on the above field
Establishing criteria of warnings
DRR collaboration meetings
Development of web site for mobile device
Development of mobile application for weather information
Public awareness activities in Southern Luzon
Production of awareness materials (class room lectures, experimental kits and posters)
Holding Annual seminars on weather related topics
Holding JCC meetings
(Production of project PR materials)

2016.01.25

List of Counterpart

(a) Project Director
Dr. Vicente B. Malano, Acting Administrator, DOST-PAGASA

(b) Project Manager
Dr. Esperanza O. Cayanan, Chief of NCR PRSD

(c) Assistant Project Manager
(d) Dr. Landrico U. Dalida, OIC, Office of the Deputy Administrator for Operations and Services
Mr. Roberto S. Sawi, AWSC, Weather Division

(e) Project Coordinator
Mr. Raymond C. Ordinario, Weather Specialist I, Weather Division
Ms. Angelina S. Galang, Weather Specialist I, Administrator's Office

(f) Counterpart Personnel
C/P personnel are expected to work closely with the JICA Experts.

- Weather Division
  Mr. Renito B. Paciente
  Mr. Vicente P. Palcon
  Ms. Samantha Christine V. Monfero

  Engineering and Technical Services Division
  Mr. Edwin Manresa
  Mr. Fulgencio A. Austria
  Mr. Harry V. Alcantara

- Research and Development and Training Division
  Dr. Cynthia P. Celebre
  Ms. Edna Seachon
  Mr. Ferdinand Y. Barcenas
  Ms. Marichu Charito J. Zarate

- Southern Luzon PRSD
  Mr. Eufronio H. Garcia
  Ms. Lilian N. Guillermo
  Mr. Allan T. Almojuela
  Mr. Melvin C. Almojuela
  Mr. Michael D. Francisco
  Ms. Josie J. Mendoza
  Ms. Ma. Cyd A. Sena
  Mr. Ariel R. Zamudio
  Mr. Felion Corona
  Mr. Fernando Pantoja

- NCR PRSD
  Ms. Julie M. Nimes
  Mr. Arman R. Griarte

- Administrator's Office
  Ms. Elena V. Tan
  Ms. Nancy T. Lance
  Ms. Fe V. Marquez

(g) Technical Working Group Counterpart Personnel

- Meteorological Instruments Group

Mr. Ferdinand Y. Barcenas	ETSD
Ms. Michelle M. Familaren	ETSD

Ms. Marilyn V. Medina,	NCR PRSD	
Mr. Arman R. Griante	NCR PRSD	

- Radar Maintenance Group

Mr. Edwin Manresa	ETSD	
Mr. Fulgencio A. Austria	ETSD	
Mr. Johny C. Zabala		SLPRSD
Mr. Marianito Macasa	SLPRSD	
Mr. Eufronio H. Garcia	SLPRSD	
Mr. Rogelio T. Bagadiong	ETSD	

- SATAID/ Radar data correction Group

Mr. Robert Sawi	WD
Mr. Vicente Manalo III	WD
Ms. Maria Ana Glaiza Escullar	WD
Mr. Charlie Rapadas	WD
Mr. Vicente P. Palcon Jr.	WD

- Weather Guidance Group

Ms. Samantha Christine Monfero	WD	
Mr. Raymond C. Ordinario		WD
Mr. Resly George Amador	WD	
Ms. Shirley J. David		RDTD
Mr. Larry Ger B. Aragon	RDTD	

- Web site Improvement Group

Mr. Roberto S. Sawi		WD	
MS. Samantha Christine V. Monfero		WD	
Mr. Raymond C. Ordinario			WD
Mr. Rene Gumapal			ETSD

- Public Awareness Group

Ms. Edna T. Seachon	RDTD	
Ms. Venus Valdemoro	RDTD	
Mr. Ferdinand Castillo	RDTD	
Ms. Melanie Aquino	RDTD	
Ms. Sharon Juliet Arruejo		RDTD

- Quantitative Precipitation Estimates Group

Michael Bala	RDTD	
Ramjun Sajulga	RDTD	
Evan James Carlos		RDTD
Resly George Amador	WD	

MINUTES OF MEETING
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
PHILIPPINE ATMOSPHERIC, GEOPHYSICAL
AND ASTRONOMICAL SERVICES ADMINISTRATION,
DEPARTMENT OF SCIENCE AND TECHNOLOGY
ON
PROJECT FOR ENHANCING THE CAPACITY ON WEATHER OBSERVATION, FORECASTING AND WARNING

Japan International Cooperation Agency (hereinafter referred to as "JICA"), the Philippine Atmospheric, Geophysical and Astronomical Services Administration, The Department of Science and Technology (hereinafter referred to as "PAGASA") and other Philippine authorities concerned have discussed several major issues during the Sixth Joint Coordination Committee (hereinafter referred to as "JCC") Meeting for the Project for Enhancing the Capacity on Weather Observation, Forecasting and Warning (hereinafter referred to as "J-POW Project") on the 18th of October 2016 at Amihan Conference Room, PAGASA Science Garden Complex, Agham Road, Diliman, Quezon city.

Both Philippine and Japanese sides exchanged views with respect to the desirable measures to be taken by the PAGASA and the Project Team (hereinafter referred to as "the Team") for the successful implementation of the Project.

As a result of the discussions, the PAGASA and the Team have agreed on the matters referred in the document attached herewith.

Quezon City, 18th October 2016

佐藤信夫

Mr. Nobuo Sato
Chief Advisor and Expert on Weather Forecasting/Administration
and
J-POW Project

Dr. Vicente B. Malano
Administrator
Philippine Atmospheric, Geophysical Astronomical Services Administration
Department of Science and Technology

Witness by:

森田隆博

Mr. Takahiro Morita
Senior Representative
JICA Philippines Office

Highlights and Discussions of the Meeting

Evaluators from Japan and Philippines conducted the Joint Terminal Evaluation on J-POW project from September 29th to October 17th 2016 right before the 6th JCC meeting. Accordingly, the summary of "Terminal Evaluation Report" was presented to discuss about solutions and next actions to obtain further improvement in another six months efficiently. This became the main agenda in the 6th JCC meeting. Minutes of Meeting for the discussion of the terminal evaluation on the project was separately created and signed.

As the regular contents, "Highlights and Businesses Arising from Previous JCC meeting" was introduced by PAGASA, and The Expert Team also made the presentations on "J-POW Comprehensive Report of Project Progress" for each output, and Discussion for "Future Plan of Project" followed by Q&A.

The subjects presented, discussed, and matters agreed for the project are as follows:

1. Highlights

a) Achievement of Output-1 (Radar Maintenance and Meteorological Observation)
Evaluation rating: Moderately achieved.
Remaining tasks are:

(i) Improvement of traceability to the provincial level
(ii) Utilization of the newly installed calibrated equipment
(iii) Follow up the submission of monthly reports by the local observatories to the central office regarding radar and surface observation

b) Achievement of Output-2 (SATAID, Southern Luzon rain gauge installation and guidance)
Evaluation rating: Moderately achieved.
Remaining tasks are:

(i) Further data collection for Quantitative Precipitation Estimate (QPE) during heavy rain events
(ii) Discussion for scan angles by radars for QPE
(iii) Operational temperature guidance with Forecasters Work Support System (FxWSS) development

c) Achievement of Output-3 (Warning Criteria)
Evaluation rating: Partly achieved.
Remaining tasks are:

(i) Archiving disaster records and automatic raingauge (ARG) data
(ii) Validation/Improvement of Warning Criteria developed by Southern Luzon PRSD using new /latest data.

d) Achievement of Output-4 (Mobile website and application)
Evaluation rating: Mostly achieved.
Remaining task is promotion for utilization of the mobile website and application at provincial level.

e) Achievement of Output-5 (Awareness Raising Activities)
Evaluation rating: Mostly achieved.
Seminars were implemented at 7 junior schools for 5th/6th grade pupils.
Remaining task is enhancement of activities to include local Disaster Risk Reduction Management Officers (DRRMOs) in the future.

f) Achievement in Project Purpose
Evaluation rating: Achievement for the Indicators on the Project Design Matrix (PDM) is

relatively high.
Remaining tasks are:

(i) Follow up on confirming operational ratio of 3 radars
(ii) Development of FxWSS for temperature guidance operation
(iii) Conduct a follow-up survey on the effectiveness of the awareness raising activities in the pilot area affected by typhoon (scheduled in December).

g) Contributing Factors

(i) Continuous involvement and effort by TWGs (Technical Working Group) from the beginning to the end.
(ii) PAGASA Modernization Act in 2015.

h) Inhibiting Factors

(i) Absence of data: disaster records.
(ii) Web administrative order for governmental website, and risks in sustainability at two TWGs (QPE and guidance: activities on top of their regular tasks).

2. Discussions

The expert team made the presentations on "Comprehensive progress report, and facilitated Q& A Discussion for "Future Plan of Project" The main points of each Output are as follows:

a) **Risks in sustainability at two TWGs for QPE and guidance (Output 3: Warning Criteria)**

Dr. Cayanan explained to JICA that PAGASA intends to issue a Memorandum for the operational use of temperature guidance. To limit the sustainability risks for two TWGs of QPE and Guidance, PAGASA will issue a Special Order for the current members of the respective TWG to continue the activities of QPE and guidance as aside from their regular tasks The team will continue to do verification of guidance and challenge for the rain and wind guidance related to development of 'rainfall warning system'.

Mr. Sato, JICA expert reminded PAGASA that JMA ensemble forecasts can provide information on possibility of heavy rain. Also, he mentioned that QPE and ARG/AWS for monitoring of heavy rain are useful in precipitation forecast.

b) **Application development for iphone in Output 4 (Meteorological Information)**

The position of the development of mobile phone APP and application for Android is done in Output 4. As the answer for a question about possibility of another application development for iphone, the Consultant Team pointed out that PAGASA is the one who need to take initiative for carrying out further modification and development including ones for the other OSs.

c) **Possibility of expansion of the sharing knowledge in Output 5 (Awareness Raising Activities)**

With regards to the possibility of expanding project area to nationwide and add more pilot schools in the project for Output 5, the Consultant Team explained that there have been some communications with DepEd for additional plans in Region-V.

The team also explained their future prospect that the teachers and educational staff who joined and learned at the seminars in the seven pilot schools would share their

knowledge to the other schools. Those educational materials have been already shared to DepEd.

Ms. Valdemoro, the project member for Output 5 informed that DepEd was asking permission for the pilot schools to share the educational materials with other schools. PAGASA will officially issue the "go signal" to provide them after final assessment of the awareness materials.

Dr. Cayanan shared an experience of PAGASA regarding development of educational books by USAID done few years ago. Those books have been shared with DepEd, however, it shows difficulties to get introduced to the local levels due to the issues of sharing structure, way of knowledge sharing, and so on. PAGASA would negotiate effective ways to share educational materials with DepEd and Region V agencies.

d) Daily monitoring and modification on the project for Output 2b (Weather Guidance)

Mr. Akatsu, JICA senior advisor pointed that weather guidance expected on PDM was MOS (Model Output Statistics) however the result of this project greatly exceeded the original goal. He admired the achievement of the project for Output 2b that "Operational Guidance and Kalman Filter Guidance" is the first successful case in the many projects relate to weather and disaster prevention implemented by JICA ever, therefore JICA expects PAGASA to develop and continue operational guidance as the good sample for the other related projects.
Mr. Akatsu also provided an advice that PAGASA should continue daily monitoring and modification to keep good conditions, though there would be some obstacles for the success in operational guidance.

Dr. Cayanan responded for the advice as she shared PAGASA's plan about assignment of a technical application team for the monitoring task. She also provided her opinion that the improvement of human resources in collaboration of technical development and adoption of new techniques will be meaningful, not just introducing it as black box.

3. Miscellaneous

Concluding remarks and adjournment

Engr. Catalino L. Davis, Deputy Administrator for Administration and Engineering Services provided closing remarks that some issues remained has been mostly solved Since the last JCC, and results of terminal evaluation are very satisfactory. He expressed his expectation that remaining matters reported that day will be settled by the next JCC next year. He also mentioned about the past US project "Educational textbook for typhoon warning" for 5/6 grades pupils in junior schools as a succeeded case, and explained PAGASA's intent to collaborate with the other agencies to maximize the output of the project.

(End of Meeting)

Appendixes:
1. Agenda of 6th JCC meeting

6th Joint Coordination Committee (JCC) Meeting for J-POW PROJECT

(JICA Project for Enhancing Capacity on Weather Observation, Forecasting and Warning)

Amihan Conference Room, PAGASA Science Garden, Agham Road, Quezon City

18th October 2016; 1:00 PM to 4:00 PM

I. Call to Order	**Dr. Vicente B. Malano** Administrator, PAGASA Project Director, J-POW Project
II. Statement	**Mr. Takahiro Morita** Senior Representative, JICA Philippines Office
III. Highlights and Business Arising from previous JCC	**Dr. Esperanza O. Cayanan** Chief, Weather Division, PAGASA Project Manager, J-POW Project
IV. Result of Joint Terminal Evaluation a) Presentation b) Q & A	**Ms. Yuko Tanaka** Consultant, Tekizaitekisho LLC
V. Project Progress Reports & Discussion for Future Plan of Project a) Warning Criteria (Output-3)	**Mr. Nobuo Sato** Chief Advisor, J-POW Project
b) Comprehensive Report Radar Maintenance (Output-1a) Weather Observation (Output-1b) Weather Guidance (Output-2b) Meteorological Data Analysis (Output-2a) Rain Gauge Network in Southern Luzon Meteorological Information (Output-4) Awareness Raising Activities (Output-5)	**Mr. Michihiko Tonouchi** Team Leader, J-POW Project **Dr. Masao Mikami** Sub Team Leader, J-POW Project
c) Q& A Discussion for Future Plan of Project	
VI. Concluding remarks	**Engr. Catalino L. Davis** Deputy Administrator, Administrative and Engineer Services
VII. Adjournment	**Engr. Catalino L. Davis** Deputy Administrador, Administrative and Engineer Services

Moderator: Ms. Angelina S. Galang,
Weather Specialist I, Administrator's Office PAGASA
Project Coordinator, J-POW Project

MINUTES OF MEETING
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
PHILIPPINE ATMOSPHERIC, GEOPHYSICAL
AND ASTRONOMICAL SERVICES ADMINISTRATION,
DEPARTMENT OF SCIENCE AND TECHNOLOGY
ON
PROJECT FOR ENHANCING THE CAPACITY ON WEATHER OBSERVATION, FORECASTING AND WARNING

Japan International Cooperation Agency (hereinafter referred to as "JICA"), the Philippine Atmospheric, Geophysical and Astronomical Services Administration, The Department of Science and Technology (hereinafter referred to as "PAGASA") and other Philippine authorities concerned have discussed several major issues during the Seventh Joint Coordination Committee (hereinafter referred to as "JCC") Meeting for the Project for Enhancing the Capacity on Weather Observation, Forecasting and Warning (hereinafter referred to as "J-POW Project") on the 21st of April 2017 at SEAMEO Innotech in Quezon city.

Both Philippine and Japanese sides exchanged views with respect to the progress of the J-POW Project Output and discussed about the realization of the planned targets and achievement of the project objectives.

As a result of the discussions, the PAGASA and the Project Team have agreed on the matters referred in the document attached herewith.

Quezon City, 21st April 2017

Mr. Nobuo Sato
Chief Advisor and Expert on Weather Forecasting/Administration
J-POW Project

Dr. Vicente B. Malano
Administrator,
Philippine Atmospheric, Geophysical and Astronomical Services Administration,
Department of Science and Technology

Witness by

Ms. Ayumu Ohshima
Senior Representative
JICA Philippines Office

Highlights and Discussions of the Meeting

The summary of the "Joint Terminal Evaluation Report" prepared by the Japanese and Filipino evaluators was presented in the highlights and business arising from previous JCC meeting. Since this is the final JCC meeting, the .discussion focused on the accomplishments of the project after the Terminal Evaluation and on the achievement of the target indicators and overall project objectives indicated in the Project Design Matrix (PDM).

After the "Highlights and Businesses Arising from Previous JCC meeting" was introduced by PAGASA, the J-POW Project Team Member made the presentations on "Project Purpose, Goal, and Structure", "Summary of the J-POW Project Accomplishments" for each output, and Discussion for "Future Plan of Project". After the summary reports from each output team and discussions, the ceremony of "Hand-over of Deliverables" was performed.

The subjects presented, discussed, and matters agreed for the project are as follows:

I. Highlights and Business Arising from previous JCC

1) Review of the Terminal Evaluation

The following evaluation ratings were reviewed for each Output team.
(i) Output 1a and 1b are moderately achieved.
(ii) Outputs 2a and 2b are moderately achieved.
(iii) Output 3 is partly achieved.
(iv) Output 4 is mostly achieved.
(v) Output 5 is mostly achieved.
The achievement of the project purpose was evaluated to be relatively high.

2) Highlights

From previous JCC, the Japanese experts and PAGASA counterparts have discussed the implementation plan for remaining activities per output. And the following activities have been done;
(i) Efforts towards sustainable outcome targets of two TWGs for QPE and guidance.
(ii) Public information publicity activities for Mobile Application for android and discussion for the development for iPhone Application in Output 4.
(iii) Activities to collect feedback information of awareness seminar by questionnaire.
(iv) Monitoring and continued modification of weather guidance.

II. Project Purpose, Goal, and Structure

A review of project purpose and goal was presented by the lead Japanese Expert based on the final PDM (Project Design Matrix). The structure and the strategy of the project were also reviewed briefly.

III. Project Accomplishment Reports

1) Accomplishment of Output-1 (Radar Maintenance and Meteorological Observation)

Achievements are:
(i) Radar maintenance trainings were conducted in Nov. 2015 at Aparri and Virac.
(ii) Maintenance manuals and guidance were developed.
(iii) Intensive training and follow-up training were also conducted at Virac radar from Feb. to June 2016.
(iv) As a result, The team confirmed 'Project Purpose Indicator 1: Average operation rate (i.e. data are provided to PAGASA from radars) of three radars becomes more than 80% in the third year" was achieved based on 'PAGASA 2016 Doppler RADAR Whole Year Performance Report' as 94.7 to 100.0 percent at Aparri, Virac

and Guiuan.

(v) Establishment of new standard barometer (3-sensors Digital Barometer with Calibration System)

(vi) To ensure the traceability of the instruments, continuous survey and the seminar at local observation sites and distribution of the field note were conducted.

(vii) For improving the traceability of instruments, Meteorological Instruments Maintenance Guideline and Reference Guides ware developed.

Remaining issues are:

(i) Regular maintenance reports must be reported regularly.

(ii) Stable power supple is a key factor for stable operation.

2) Accomplishment of Output-2 (Meteorological Data Analysis)

Achievements are:

(i) Improvement of satellite analysis skill through training. For this purpose, the team implemented trainings for SATAID, HIMAWARI8 and Dvorak methods and for radar data products.

(ii) For preliminary QPE experiment, the team established a Rain Gauge Network in Southern Luzon PRSD to get 10 minutes interval precipitation data, stored rain gauge and radar data from 2016, obtained data during 2 typhoon events in October and developed preliminary QPE (Quantitative Precipitation Estimation) scripts/software.

(iii) Preliminary trial of QPE at target region, Southern Luzon PRSD

(iv) Weather guidance for temperature forecast based on Kalman filter technique was successfully developed.

(v) The guidance was integrated into FAST (Forecast Assist Tool) and has started to be used in the forecast operation of PAGASA.

(vi) As a result, "Project Purpose Indicator 2: Quantitative forecasting is issued by using weather guidance" was accomplished.

Remaining issues are:

(i) ARG observation should be continued even after the project.

(ii) ARG and Radar data should be archived continuously for practicing QPE experiment.

(iii) Further development of various weather guidance should be continued after the end of the project.

(iv) There are more requirements of various product based on NWP forecast improvement of the forecast operation of PAGASA.

(v) There is a need for more staff to develop weather guidance product.

3) Accomplishment of Output-3 (Warning Criteria)

Achievements are:

(i) Conducted a workshop in SLPRSD to review the existing Rainfall Warming Criteria to verify a criteria in the case of Typhoon Nona (2015) and Nina (2016).

(ii) Revision of the SLPRSD Rainfall Warning Criteria

4) Accomplishment of Output-4 (Mobile website and application)

Achievements are:

(i) Meteorological information in the PAGASA website such as Glossary, Warning, and Bulletin was analyzed and improved.

(ii) Mobile Web site was developed (m.pagasa.dost.gov.ph/weather).

(iii) Mobile APPs for Android was developed. It is distributed through Google play.

Remaining issues are:

(i) Development of mobile apps for other platforms (iOS, Windows) to meet the demand for broader users

(ii) Monitor the User feedback on Mobile apps and continuous modification of the mobile apps based on user needs

5) Accomplishment of Output-5 (Awareness Rising Activities)
Achievements are:

(i) Awareness raising seminars at pilot region were successfully carried out and totally more than a thousand of participants that include pupils, parents, teachers, and local government DRR officials,.

(ii) Questionnaires were collected after the seminar and the results of the evaluation indicated that contents of the seminar was useful and the presentation was easy to understand.

(iii) In addition, the evaluation at post 1st seminar after Typhoon NONA occurrence indicated that the content of the seminar was very useful for disaster prevention at the time of typhoon NONA occurrence.

Remaining issues are:

(i) It is desirable that continued awareness raising activities for weather disaster prevention even after the project is over. At that time, cooperation with the region's DepEd is effective.

(ii) PAGASA will continue with other initiatives in other provinces from pilot region so that the disaster prevention base for natural hazards in all provinces in the Philippines will be strengthened.

6) Summary of Achievement

Dr. Cayanan, head of Weather Division and Project Manager PAGASA summarized the achievements of J-POW Project and concluded that achievement for the Indicators on the PDM is relatively high.

IV. Discussions

The expert team made the presentations on "Comprehensive progress report, and facilitated Q& A Discussion for "Future Plan of Project" The main points of each Output are as follows:

Q: Regarding guidelines and manuals on observation and calibration created in collaboration with PAGASA in this project, does it conforms to ISO?

A: Mr. Barcenas replied that it will be improved further to then apply for ISO certification. In addition, he reported that good performance was obtained when PAGASA's anemometer was calibrated in a wind tunnel in Japan.

Q: Can the manual and guidelines we submitted be used for the purpose of application for ISO as a requirement?

A: Mr. Barcenas answered it is not yet done but it can still be improved for the purpose.

Comment: Dr. Dalida informed that PAGASA will acquire additional wind tunnels, one for the Visayas (Cebu) and the other in Mindanao.

Mr. Barcenas made an additional comment on this that their present wind tunnel 75 m/s will be transferred to Mindanao and the new 100 m/s will be installed in central office and the other 100m/s to Cebu. It will be in the process of bidding this year.

Comment: PAGASA pointed that the team should store additional rain gauge and radar data during heavy rain events for future QPE development.

Output 2-a presenter agreed the importance of data storage especially during heavy rain events, and confirmed to continue data storage.

Q: There was a question from Dr. Dalida concerning the MOS guidance equation developed in this project.

A: The presenter of Output 2-b explained that the forecast equation of temperature guidance with Kalman filter technique was not fixed one but was updated everyday in order to realize the best accuracy.

Q: Dr. Dalida ask if the project includes the established rainfall threshold by Albay PDRRMO.
A: The presenter of Output 3 replied that the project focuses on flooding first but we will improve the Rainfall Warning Criteria and will use the threshold established by Albay PDRRMO.

Q: The question from DOST is on the inclusion of expected landslide on the red warning level and if PAGASA is the one responsible for this type of warning.
A: Dr. Malano replied that there is an initiative of the Philippine government to harmonized different warning thru a multi hazard warning system of different government agencies.

Q: The question from OCD regarding on who will be responsible in issuing localized rainfall warning since we discussed that the rainfall threshold is highly localized.
A: The presenter of Output 3 replied that the warning should be issued by the PRSD.

Q: The question from OCD regarding on who will be responsible in issuing localized rainfall warning since we discussed that the rainfall threshold is highly localized.
A: The presenter of Output 3 replied that the warning should be issued by the PRSD.

Comment: In addition to DepEd DRR section, we should involve the Philippine Information Agency (PIA) in the production of information materials and as partner in the raising awareness seminar.
A: The presenter of Output 5 replied that it is worth for consideration. We would like to involve the Philippine Information Agency (PIA) in the future, however in the Output 5 conduct of Raising Awareness and in the development of information materials like poster and power point presentations we involved the School DRR Focal Person in the Pilot areas, the science teachers and the school principal. While the production of radio plugs the PIA, PDRRMO and Broadcasters were involved. It is worth mentioning that even if the radio plug is in Filipino, the local broadcaster translated the material into local dialects (Bicolnon and Waray). The presenter also informed the body that the information produced by Output 5 were first presented with Technical Personnel of PAGASA and JPOW Staff for comments before we conducted the pre-test in identified schools in Sorsogon and Northern Samar.

Q. Why limit the number of students in the awareness seminar?
A. The 50 students per session was targeted as participants since it is the ideal number per class and of course in addition to the students, we invited more that 50 parents and teachers as observers per area. However, to address the issue of more people should be informed and updated on the focused topic for 1st awareness like tropical cyclone and storm surge and for 2nd awareness raising which was focused on FLOOD the strategy is the developed and aired radio plugs in local radio stations.

Additional Remarks from the Presenter

It is worth mentioning that in the Consultation meeting with Regional DEPED, it was attended by no less than the Regional Director, Assistant Regional Director and Schools Division Superintendent and Schools DRR Focal Persons. In fact, they were appreciative of the project and requesting for the educational /information materials for replication in their respective areas.

Further, the presenter announced that this coming July 2017 in the celebration of the National Science and Technology Week, one of the activities is a Disaster Summit for 500 School children as participants and will be using the materials produced by the J-POW Project.

V, Miscellaneous

Concluding remarks and final comments from JICA Senior Advisor

Dr. Dalida, Deputy Administrator for Operations &Services, PAGASA, expressed his deep thanks for Output team members for their efforts to achieve outcome goals. He also expressed his gratitude for the project's great achievements.

Mr. Akatsu, Senior Advisor (professional engineer), JICA, as a concerned coordinator who has been involved from the beginning of this project, expressed his great pleasure to find the project finalized with fruitful results. He also mentioned that JICA would support activities of PAGASA and related agencies from DRR (Disaster Risk Reduction).

(End of Meeting)

Appendixes:
1. Agenda of 7thJCC meeting

7th Joint Coordination Committee (JCC) Meeting
JPOW PROJECT

(JICA Project for Enhancing Capacity on Weather Observation, Forecasting and Warning)

L.B. Soriano Hall, SEAMEO Innotech, Commonwealth Ave., Diliman, Quezon City

21st April 2017; 9:00 AM to 12:00 NN (Registration : 8:30 AM)

I. Call to Order and Opening Statement	**Dr. Vicente B. Malano** Administrator, PAGASA Project Director, JPOW Project
II. Highlights and Business Arising from previous JCC	**Dr. Esperanza O. Cayanan** Chief, Weather Division, PAGASA Project Manager, JPOW Project
III. Project Purpose, Goal, and Structure	**Mr. Michihiko Tonouchi** Project Manager, J-POW Project
IV. Project Accomplishment Reports	
a) Radar Maintenance (Output-1a)	**Mr. Fulgencio A. Austria, Jr.** Weather Facilities Specialist II, ETSD, PAGASA
b) Meteorological Data Analysis (Output-2a)	**Mr. Ramjun Sajulga** Weather Facilities Specialist I, RDTD, PAGASA
c) Weather Observation (Output-1b)	**Mr. Ferdinand Y. Barcenas** Weather Specialist II, IRDU, PAGASA **Mr. Koji Matsubara** Expert, J-POW Project
d) Weather Guidance (Output-2b)	**Mr. Raymond Ordinario** Weather Specialist I, WD, PAGASA **Mr. Ryusuke Taira** Expert, J-POW Project
e) Warning Criteria (Output-3)	**Mr. Eufronio Garcia** Officer-in-Charge, SLPRSD PAGASA **Mr. Nobuo Sato** Chief Advisor, J-POW Project
f) Meteorological Information (Output-4)	**Ms. Samantha Christine V. Monfero** Senior Weather Specialist, WD, PAGASA
g) Awareness Raising Activities (Output-5)	**Ms. Venus Valdemoro** Administrative Officer V, RDTD, PAGASA
h) Summary of Achievements	**Dr. Esperanza O. Cayanan**
V. Hand-over of Deliverables	**Dr. Masao Mikami** Sub Project Manager, JPOW Project
VI. Concluding Remarks	**Dr. Landrico U. Dalida** Deputy Administrator for O&S, PAGASA
VII. Adjournment	**Dr. Vicente B. Malano** Administrator, PAGASA Project Director, JPOW Project

Emcee: Mr. Raymond C. Ordinario,
Weather Specialist I, Weather Division, PAGASA

MINUTES OF MEETINGS

BETWEEN

THE JAPANESE TERMINAL EVALUATION TEAM AND THE AUTHORITIES CONCERNED OF THE GOVERNMENT OF THE PHILIPPINE

ON

THE JAPANESE TECHNICAL COOPERATION

FOR

PROJECT FOR ENHANCING CAPACITY ON WEATHER OBSERVATION, FORECASTING AND WARNING

The Japanese Terminal Evaluation Team (hereinafter referred to as "the Team"), organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA") and headed by Mr. Yoichi Inoue, Acting Director of Disaster Risk Reduction Team 1, Global Environment Department, visited the Republic of the Philippines from September 28 to October 19, 2016 for the purpose of conducting the terminal evaluation on the Japanese technical cooperation for project for enhancing capacity on weather observation, forecasting and warning (hereinafter referred to as "the Project").

During its stay, both the Team and the Philippine side formulated the Joint Evaluation Team, exchanged the views and had a series of discussions on the Project with the Philippine authorities related and concerned. As a result of the discussions, the Team submitted the report as attached (Annex-1) and both Philippine and Japanese sides (hereinafter referred to as "Both sides") agreed upon the descriptions of the report and the attached document.

Quezon City, October 18, 2016

井上陽一

YOICHI INOUE
Team Leader
Terminal Evaluation Team
Japan International Cooperation Agency (JICA)

VICENTE B. MALANO, PhD, MNSA
Administrator
Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA)

ATTACHED DOCUMENT

1. Joint Terminal Evaluation:

Both sides agreed the result of the Joint Terminal Evaluation as Annex 1.

2. Recommendations and lesson learned:

A series of recommendations and lessons learned are written in the Report. Below points are to be highlighted by the Team because of its importance.

Recommendations to be considered during the Project period (until May 2017)

1. For traceability of meteorological instruments (indicator 1-1 of Output 1), the Project mainly focused on improvement of atmospheric pressure. The Project also compared existing reference standard for thermometer with JMA's travelling standard. In order to operationalize traceability at the local level, it is advised for RDTD to coordinate with ETSD to assure that the calibrated instrument is utilized at the local level after installation. At the same time, it is important to educate staff members at local Synop/AWS stations for the importance of utilizing newly installed instruments. It is also recommended to discuss importance of Quality Control (QC) to assure (traceability) accuracy of meteorological instruments.
2. To follow up if the monthly maintenance reports including equipment status report at radar sites are regularly reported to ETSD. At the same time, it is advised to assure if equipment status reports of other meteorological instruments are regularly reported to ETSD as is instructed in MASSO.
3. For early development of QPE system and setting up criteria for warning, it is necessary to archive precipitation data from radar stations and ARG/AWS. A workshop on the assessment of warning criteria and development of new threshold values is recommended when more data has been collected.
4. For future development of precipitation guidance, it is necessary to assure archive of precipitation data (ARG/AWS).
5. The Project is advised to steadily complete the "Automation Production System of Weather Guidance" and to launch the operation of "Forecast work support system (FxWSS)".
6. For warning criteria in SL-PRSD, it is advised to i) operationalize the warning criteria set in Legaspi and evaluate, ii) to assess whether the provisional warning criteria is also applicable to ARG sites, by comparing precipitation data and disaster data (such as flood).
7. Regarding the elevation angle of radars, it is suggested to JICA expert in charge of QPE to write a letter to WD to propose modification of the elevation angle of three JRC radars. It is important for observation of not only typhoons but also rain clouds.
8. It is recommended to promote mobile application and mobile website not only to NCR but also provinces. It is recommended that local DRRMOs be involved in IEC activities as member of TWG to complement resources of the Project.

ANNEX:

ANNEX 1: Joint Terminal Evaluation Report

ANNEX I

Terminal Evaluation Report
on Japanese Technical Cooperation
for
the Project for Enhancing Capacity on Weather Observation, Forecasting and Warning
in the Republic of the Philippines

Japan International Cooperation Agency
and
Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)

October 2016

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ANNEX LIST

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LIST OF ABBREVIATIONS

ARG	Automatic Rain Gauge
AWLG	Automatic Water Level Gauge
AWS	Automatic Weather Station
C/P	Counterpart
DRRM	Disaster Risk Reduction and Management
DOST	Department of Science and Technology
EFCOS	Effective Flood Control Operation System
ETSD	Engineering and Technical Services Division, PAGASA
FFWS	Flood Forecasting and Warning System
GIS	Geographic Information System
HMD	Hydrometeorology Division
JCC	Joint Coordinating Committee
JICA	Japan International Cooperation Agency
JMA	Japan Meteorological Agency
JOCV	Japan Overseas Cooperation Volunteer
JPY	Japanese Yen
M&E	Monitoring and Evaluation
MM	Man-Month
NCR	National Capital Region
NCRPRSD	National Capital Region PRSD
NEDA	National Economic and Development Authority
NDRRMC	National Disaster Risk Reduction and Management Council
NLPRSD	Northern Luzon PRSD
NWP	Numerical Weather Prediction
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PDM	Project Design Matrix
PO	Plan of Operations
PRSD	PAGASA Regional Services Division
QPE	Quantitative Precipitation Estimation
R/D	Record of Discussions
RDTD	Research and Development Training Division, PAGASA
SATAID	Satellite Animation and Interactive Diagnosis
SL-PRSD	Southern Luzon PRSD
SYNOP	Surface Synoptic Observation
WD	Weather Division, PAGASA

1. OUTLINE OF THE TERMINAL EVALUATION STUDY

1.1 Background of the Terminal Evaluation

The Philippine archipelago, located near the western edge of the Pacific Ocean with a population of 94 million people (based on the 2010 Census), is in the direct path of seasonal typhoons and monsoon rains which bring floods, storm surges, and their attendant landslides and other forms of devastating natural disasters. According to the Office of Civil Defense (OCD), 12 tropical storms and typhoons in 2011 alone had caused 1,557 deaths and adversely affected more than 3.5 million people. Every year, the Philippines experiences huge economic losses coupled with serious human anguish and sufferings caused by destructive tropical cyclones that cross the country. Tropical cyclones repeatedly caused significant damage to agriculture which is a vital industry in the Philippines, thereby inflicting widespread poverty on its people. Extensive damages from tropical cyclones have caused significant set-backs of the national economy and adversely affected the people's standard of living in the Philippines. In this context, the establishment of effective weather forecasting and warning system is considered by the Government of the Philippines (GOP) one of the top development agenda.

The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) is the sole national meteorological service provider in the Philippines operating under the administrative supervision of the Department of Science and Technology (DOST). Its main responsibility as a National Meteorological Service is to record meteorological observations round the clock and to provide weather information, forecasts, advisories and warnings necessary to mitigate and prevent widespread damages from natural disasters and therefore contribute to the improvement of socio-economic conditions.

In order to effectively protect lives and properties from tropical cyclones, it is important to establish a reliable and timely dissemination of public storm warning signals and tropical cyclone information to the public and disaster management agencies [e.g. OCD, The Philippine Coast Guard (PCG) and the local government units (LGUs), among others]. Under this circumstance, the Government of the Philippines (GOP) requested the Government of Japan (GOJ) for a grant assistance to improve the meteorological radar system in the Philippines. In response, the GOJ through JICA assisted PAGASA in implementing the "Project for Improvement of the Meteorological Radar System" between 2009 and 2013 under Japan's Grant Aid program. The project established three Doppler radars in Virac (Catanduanes Island), Aparri (Luzon Island) and Guiuan (Samar Island) and included the procurement and installation of required equipment, construction of appropriate radar tower buildings, as well as provision of relevant systems and facilities.

The full utilization of procured equipment and installed systems is crucial to achieve effective forecasting and dissemination of meteorological and disaster-related information to the public and disaster management agencies. In order to strengthen the capacity of PAGASA staff in utilizing the system and disseminating warning information, the GOP again requested GOJ this time for a technical assistance. In response, the GOJ through JICA assisted PAGASA in implementing the "Project for Enhancing Capacity on Weather Observation, Forecasting and Warning" under JICA's Technical Cooperation Program (TCP) from April 2014 to May 2017.

In order to review the progress of implementation and project achievements as well as identify measures to ensure successful project completion in May 2017, JICA conducts the Terminal Evaluation for the project and dispatched the Terminal Evaluation Team to the Philippines during the last days of September 2016

until the third week of October 2016.

1.2 Objectives of the Terminal Evaluation

The Objectives of the Terminal Evaluation are as follows;

(1) To verify the level of achievement of the Outputs and the Project Purpose as indicated in the Project Design Matrix (PDM);
(2) To identify factors that promoted or inhibited the performance of the Project;
(3) To analyze the JICA's technical cooperation and overall project intervention from the point of views of the five evaluation criteria; and
(4) To identify recommendations and extract lessons for planning and implementing similar technical cooperation projects in the future.

1.3 Members of the Terminal Evaluation Team

The Terminal Evaluation was conducted jointly by representatives of both Japanese and Philippine Governments. The Terminal Evaluation Team is composed of the following members:

1.3.1 Japanese Side:

Name	Designation	Position, Organization
1 Mr. Yoichi Inoue	Team Leader	Acting Director, Disaster Risk Reduction Team I, Global Environment Dept., Japan International Cooperation Agency (JICA), Tokyo, Japan
2 Mr. Kunio Akatsu	International Meteorology	Senior Advisor, Japan International Cooperation Agency (JICA), Tokyo, Japan
3 Ms. Yuko Tanaka	Evaluation Analysis	Consultant, Tekizaitekisho LLC, Tokyo, Japan
4 Mr. Rey Gerona	Evaluation Analysis 2	In-house consultant for Project Formulation, M&E and Capacity Building for Partner Organizations, JICA Philippines Office

1.3.2 Philippine Side:

Name	Position, Organisation
1 Mr. Ryan Christopher P. Viado	Senior Science Research Specialist of the Energy and Utilities Systems Technology Development Division (EUSTDD), DOST
2 Ms. Thelma A. Cinco	Section Chief, Impact Assessment Application Division, CAD, PAGASA
3 Engr. Roy A. Badilla	OIC, Hydro-meteorological Division, PAGASA

1.4 Schedule of the Terminal Evaluation

The evaluation was conducted from September 29, 2016 to October 19, 2016. The detailed schedule of the Terminal Evaluation is attached as **Annex 1**.

1.5 Stakeholders Consulted/Interviewed

The stakeholders who were consulted or interviewed for the Terminal Evaluation consisted mainly of the following:

- Japanese experts assigned to the Project

- Counterparts (C/Ps) from PAGASA
- Related stakeholders in Sorsogon, Legazpi, and Virac

The detailed list of the persons consulted is attached as **Annex 2**.

1.6 Methodology of the Terminal Evaluation

1.6.1 Procedure

The PDM version 1 (see **Annex 3**) is adopted as a framework of the Terminal Evaluation. The Terminal Evaluation Team (hereinafter referred to as "the Team") conducted surveys by questionnaires and interviewed the counterparts (hereinafter referred to as "C/P") and the Japanese experts (also referred hereinafter as "JICA experts") as well as those officials concerned with the Project. Both quantitative and qualitative data were gathered and utilized for analysis. Data collection methods used for the evaluation were as follows:

- Literature/Documentation Review;
- Questionnaires;
- Individual and/or group interviews;
- Direct Observations

1.6.2 Items of the Terminal Evaluation

(1) Achievement of the Project

Achievement of the Project is measured in terms of the progress of the provision of Inputs, extent of the production of Outputs, and the extent of achieving the Project Purpose, with reference to the Objectively Verifiable Indicators identified in the PDM version 1.

(2) Implementation Process

In order to identify promoting and inhibiting factors affecting performance of the project, implementation process is reviewed from various viewpoints, including communication among stakeholders, monitoring and project management, among others.

(3) Analysis based on the Five Evaluation Criteria

Based on the observations made under the previous two items, the Project is assessed from the viewpoints of the Five Evaluation Criteria defined by JICA and originally espoused by the DAC (OECD)[1] shown in Table 1-1 below.

[1] DAC website on Criteria for Evaluating Development Assistance (accessed on 29 August, 2015) http://www.oecd.org/dac/evaluation/daccriteriaforevaluatingdevelopmentassistance.htm

Table 1-1 Summary Definition of the Five Evaluation Criteria

Five Evaluation Criteria		Definitions as per JICA Evaluation Guidelines
1.	Relevance	Relevance of the Project is reviewed by examining the validity of the Project Purpose and Overall Goal in connection with the Philippine Government's development policy and the needs of the target groups and/or ultimate beneficiaries.
2.	Effectiveness	Effectiveness is assessed by examining the extent to which the Project has achieved its Project Purpose, clarifying the relationship between the Project Purpose and Outputs.
3.	Efficiency	Efficiency of the Project implementation is analysed with emphasis on the relationship between Outputs and Inputs in terms of timing, quality and quantity.
4.	Impact	Impact of the Project is assessed in terms of positive/negative, intended/unintended influence caused by the Project.
5.	Sustainability	Sustainability of the Project is assessed in terms of institutional, financial and technical aspects by examining the extent to which the achievements of the Project will be sustained after the Project cooperation is completed.

Source: JICA Project Evaluation Guidelines (June 2010), JICA

2. OUTLINE OF THE PROJECT

The outline of the Project summarized in the PDM (version 1) is as follows. The Project Purpose indicators down to the Inputs are expected to be achieved during the cooperation period or until May 2017; while the Overall Goal indicators are expected to be achieved within three to five years after the completion of the Project[2].

2.1 Overall Goal

Capacity of all PRSDs is enhanced in terms of weather observation, forecasting and warning.

2.2 Project Purpose

Capacity of PAGASA Central Office and Southern Luzon PRSD is enhanced in terms of weather observation, forecasting and warning.

2.3 Outputs

There are five Outputs in this Project, namely:

1. Capacity on weather observation is improved.
2. Capacity on meteorological data analysis and forecasting is improved.
3. Criteria of warnings are elaborated at Southern Luzon PRSD.
4. Content and accessibility of meteorological information are improved.
5. Activities of awareness-raising on meteorological information are improved at Southern Luzon PRSD.

[2] According to JICA Project Evaluation Guidelines (June 2010)

3. ACHIEVEMENT AND IMPLEMENTATION PROCESS

3.1 Inputs

Inputs to the Project as of October 2016 since its inception are as follows:

3.1.1 Japanese Side

a) Dispatch of the JICA experts

Long-term Experts: A total of two long-term experts were assigned and dispatched to the Project since its commencement. The areas of expertise as well as contract period of long-term experts are shown in the following table.

Table 3-1 Summary of Long-term Experts

Areas of Expertise	Contract Period
Chief Advisor/ Meteorological Administration	May 2014 – May 2016
Project Coordinator / Specialist (Training Program/Public Relation)	June 2014 – June 2016

Source: Data provided by the Project

Short-term Experts (Japan): A total of 40.43 man-months[3] (MM) were allocated for the assignment of 11 short-term experts from Japan. The following table shows the allocation of MM for each area of expertise.

Table 3-2 Summary of Short-term Experts (Japan)

Areas of Expertise / Terms of Reference (TOR)	Total Man-months (MM)
Chief Advisor/ Meteorological Administration	6.23
Previous Project Manager/ Awareness-raising activities	4.20
Sub Project Manager/ Awareness-raising activities	3.53
Project Manager/ SATAID	3.50
Observation	7.63
Radar maintenance and operation	1.37
Radar maintenance and operation hard ware	2.77
Radar maintenance and operation soft ware	0.26
Guidance	4.93
Weather information and communication	7.97
Awareness-raising activities	4.27
Total	40.43

Source: Data provided by the Project

The detailed lists of the experts are attached as **Annex 4.**

b) Training in Japan

[3] Includes provisional assignment will March 2017.

As of October 2016, a total of four (4) counterparts from PAGASA were sent to Japan for training. The overview of the mentioned training/workshop is shown below.

Table 3-3 Summary of the Training in Japan

Name of the Training	Number of Participants	Duration
Weather Forecasting	4	Oct 12 – Oct 24, 2015 (13 days)

Source: Data provided by the Project

c) Local Expenses

A total of **JPY6,147,764** were provided by Japanese side as a local cost. The local cost includes car rentals ~~cars~~, consumables, domestic travel costs including air fare, accommodation and per-diem, telecommunications and teaching materials. The summary of the local expenses is shown in the following Table.

Table 3-4 Summary of Local Expenses

Items	Amount (JPY)
Rental cars	4,252,592
Consumables	30,648
Domestic travel cost	1,250,746
Telecommunications	77,825
Teaching materials	280,199
Other expenses	255,753
Total	6,147,763

Source: Data provided by the Project

d) Equipment

A total of **PHP7,894,000** worth of equipment was provided by Japanese side. Equipment provided by the Project includes OA equipment such as office PCs, photo copy, printers, projectors, as well as calibration equipment and equipment for ARG network. Additional PHP482,045 was spent for the transportation of equipment. The detailed list of equipment is attached as **Annex 4**.

3.1.2 Philippine Side

a) Assignment of Counterparts

As of October 2016, a total of 36 personnel from PAGASA are assigned as counterparts (C/Ps) to the Project. They are three administrative officers from DOST-PAGASA, thirteen (13) from Weather Division (WD), nine (9) from Engineering and Technical Services Division (ETSD) and eleven (11) from Research and Development Training Division (RDTD). In addition, staff members from the PAGASA Southern Luzon Regional Services Division (SL-PRSD) are assigned as the Project C/Ps. List of counterparts and related stakeholders are attached as **Annex 4.**

b) Provision of Facilities for Project Operations

The Philippine side secured office space within PAGASA central office for JICA experts as well as lots for rain-gauge instruments.

3.2 Achievement of the Project

3.2.1 Activities

Most of the Project's activities, as specified in the PDM (version 1) and the Project's Plan of Operation (PO) were mostly implemented as planned.

3.2.2 Outputs

Output 1: Capacity on weather observation is improved.

Output 1 is composed of two elements namely; a) Operation and maintenance of radars; b) meteorological observation. The table below shows the level of achievements of Output1 with reference to indicators specified in PDM (version 1).

Table 3-5 Level of achievement with reference to Indicators (Output 1)

Indicators as per PDM (version 1)	Major achievements	Remarks
1-1 Traceability of Instrument is improved through development of reference guides regarding maintenance and calibration.	● Traceability of barometer was improved as the Project developed the RIC Philippine reference standard for atmospheric pressure, utilizing digital barometers. ● Reference standard for thermometer already existed in PAGASA before the Project. The existing reference standard for thermometer was compared with JMA standard during the visit of short-term expert. ● For more improvement of raingauge calibration, the Project is conducting OJT on calibration procedure of raingauge on a trial basis.	● Reference standard is improved for barometer, however still needs improvement in terms of operations at the provincial level
1-2 Capability of more than 80% of staff engaged in the maintenance and calibration of SYNOP/ AWS stations and RADAR stations is enhanced.	● Short-term experts were dispatched to provide intensive training for operation and maintenance targeting at least two principal radar operators each from three Radar stations. ● Training was conducted on the maintenance and calibration of Synop/AWS, of which 175 (including 38 from Southern Luzon region) participated. 91% of the participants responded that the contents of the training was useful for their regular work, though limited information was available about the level of capacity building. ● For meteorological instruments, site visits are conducted in Synop/AWS stations to provide necessary advice and trainings.	● Educate staff at local Synop/AWS for the importance of utilizing newly installed instruments.
1-3 Maintenance reports on respective equipment (i.e. radars, synop stations and AWS) are regularly prepared and reported to the PAGASA Central Office.	● Maintenance reports are regularly prepared at Radar sites by resident technicians, however it was reported that not all the maintenance reports are regularly reported to ETSD. ● The existing "Manual of surface synoptic observation (MASSO)" regulates reporting system from local to central levels. However, limited information is available whether all equipment status reports on AWS/Synop stations are regularly prepared and reported to the PAGASA central office in compliance with MASSO.	● Follow-up necessary to see if maintenance reports, including equipment status reports are regularly reported from Radar stations, AWS/Synop.

Source: Interview and Progress Report 3

Output 1 is moderately achieved. Two technical working groups (TWG) were formed under this output, namely i) TWG on Radar maintenance and ii) TWG on Meteorological Instruments and weather observation.

As for the traceability of instruments, reference standards for thermometer and barometer already existed in PAGASA even before the Project. The existing reference standard for thermometer and barometer were compared with JMA standards during the visit of short-term experts. The comparison results were within the achievable measurement uncertainty. Traceability of barometer was improved as the Project developed the RIC Philippine reference standard for atmospheric pressure, utilizing digital barometer as it is just timely that the standard barometer of PAGASA had to be recalibrated and a more precise digital barometer and pressure pump was granted from the project. It is reported however that some Synop stations still utilize old instruments even after the installation of new instruments calibrated by RDTD. The reason behind was assumed that there was not enough time to provide sufficient instructions by ETSD after installation of new instruments and staff at the local stations are more familiar with utilizing old instruments. Therefore, the indicator 1-1 is mostly achieved for barometers, but it still needs improvement in terms of operations at the provincial level.

As for the operation and maintenance of radar sites, short-term experts were dispatched to provide intensive training for operation and maintenance targeting radar operators from three Radar stations established by Japan's Grant Aid program. During the interview with radar operators in Weather Radar Station in Virac, it was reported that radar operators trained by the project have become confident enough to conduct necessary operation and maintenance (Indicator 1-2). Maintenance reports are regularly prepared and logged at radar sites however it was reported that not all the maintenance reports are regularly reported to PAGASA central office (Indicator 1-3).

Remaining task for Output 1 is to ensure the full utilization of calibrated instruments installed newly so that the RIC Philippine reference standards for air pressure, as well as existing reference standards for temperature are to be fully utilized. For this purpose, the Project is expected to provide further guidance and instructions to Synop/AWS stations as well as officers-in charge from engineering department of PAGASA central office.

Output 2: Capacity on meteorological data analysis and forecasting is improved.

Output 2 is composed of two elements namely; a) SATAID/Radar analysis; b) meteorological guidance. The level of achievements of Output 2 with reference to indicators identified in PDM is shown in the table below.

Table 3-6 Level of achievement with reference to Indicators (Output 2)

Indicators as per PDM (version 1)	Major achievements	Remarks
2-1 Capability of 80% of the operational staff on the use of SATAID is improved.	● Project conducted various trainings such as SATAID, Dvorak method, Himawari 8. The short-term experts reported that there had been improvement of staff's capacity. ● 22 staff participated in the above-mentioned training, and it is reported that more than 80% of them enhanced knowledge on the use of SATAID after the training.	● Staff are already utilizing SATAID, the Project only provided additional knowledge through trainings and mentoring.
2-2 Software for RADAR data	● Software for Radar data calibration with rain gage data is developed.	● The software still awaits for more events (heavy rains) to be able to

calibration with raingauge data is developed.	● Continuous archiving of available radar and raingauge data since Dec 2015. ● Installation of additional 9 ARGs around Virac radar.	feed into the system. ● In order to develop QPE system, it is necessary to i) archive Radar and AWS/ARG data; ii) assure quality control of Radar data through capacity-building of numerical modeling staff; iii) calibrate radar data with ARG data. ● The observation angle mode of three JRC radars is another issue of concern for development of QPE system.
2-3 Weather guidance is developed.	● Technical working group on weather guidance began its activity from Nov. 2014 and has developed temperature guidance by utilizing Kalman filtering method. ● "Automated production system of weather guidance" is being constructed and shall be launched by the end of 2016.	● It is important to steadily complete the "Automated production system of weather guidance" and FxWSS based on the implementation plan agreed between JICA expert and PAGASA counterparts.

Source: Interview and Progress Report 3

Output 2 is moderately achieved. Two technical working groups (TWG) were formed under this output, namely: i) TWG on Quantitative Precipitation Estimation (QPE) and ii) TWG on weather guidance.

Short-term experts were dispatched to provide trainings on the use of SATAID and it is reported by the short-term experts that there had been improvement of staff's capacity on the use of SATAID (indicator 2-1). For the calibration of radar data, Radar data from Aparri, Virac and Guiuan are transmitted to PAGASA central office and the ARG data is transmitted to both PAGASA central office and SL-PRSD. Rainfall data from Radar and AWS/ARG are reported to have been archived from July 2014. However, Japanese expert team notes that rainfall data are still missing even after the mentioned date of July 2014. Indicator 2-2 is partly achieved in light of development of QPE, since it requires to i) archive Radar and AWS/ARG data; ii) assure quality control of Radar data; and iii) calibrate radar data with ARG data.

Remaining task of Output 2 is the development of QPE. This will heavily rely on the availability of rainfall data (therefore will depend on the occurrences of natural "events"). It is also necessary for the Project to assure if the data from all 9 ARGs are appropriately transmitted and archived at PAGASA central office. For the development of QPE, archive of ground rainfall data is essential as mentioned, and radars data can be utilized as equivalent data to ground raingauge. In this regard, re-arrangement of observation angle mode of three JRC radars should be considered so that radars can detect rain clouds more widely nearby 2km height from the ground with less radar false echo.

As for the weather guidance, the TWG focused first in providing an automated forecast work support system for some of the contents of PAGASA's issuance of daily weather forecasts. In particular, the TWG arrived at formulating a temperature guidance for 15 key cities included in the extended weather outlook. Operation and maintenance of the automation system will become an important issue once "Automated production system of temperature guidance" is fully launched. For this end, enhancement of technical support team for the automation system is necessary in order to sustain the automation production system of temperature guidance.

Output 3: Criteria of warnings are elaborated at Southern Luzon PRSD.

The level of achievements of Output 3 with reference to indicators identified in PDM is shown in the Table below.

Table 3-7 Level of achievement with reference to Indicators (Output 3)

Indicators as per PDM (version 1)	Major achievements	Remarks
3-1 Criteria of warnings are made at the provincial level.	● Warning criteria is provisionally set for some of the municipalities including Legazpi City in Albay Province.	● The SL-PRSD has not yet developed criteria for warnings at the provincial level. ● Need to operationalize the warning criteria set in Legazpi and evaluate ● Need to assess whether the provisional warning criteria is also applicable to ARG sites

Source: Interview and Progress Report 3

Output 3 is partly achieved. The Project actively involves SL-PRSD as the main counterpart for setting up provincial level criteria for rainfall warning. The 9 ARGs were installed in three provinces within SL-PRSD coverage in July 2016 in order to enhance the achievement of the Project. Warning criteria is provisionally set by the SL-PRSD for some of the municipalities in Albay Province in June 2015, but this is just on experimental basis that needs to be reviewed/assessed and adjusted when more rain events are gathered. This is the reason why SL-PRSD has not yet announced rainfall warning even during the event of typhoon Nona in December 2015 because the rainfall data did not reach to the assigned threshold for warning.

Remaining task for Output 3 is to strengthen data collection and archive structures of both rainfall data (through ARG and radar) and natural disaster data induced by rainfall. As for the archive of natural disaster data induced by rainfall, coordination with PDRRMO within southern Luzon region shall be strengthened. Through this project, the expert can assist in the review/assessment of the provisional criteria by way of a workshop when more data is collected on provincial level before the project ends in May 2017.

Output 4: Content and accessibility of meteorological information are improved.

The level of achievements of Output 4 with reference to indicators identified in PDM is shown in the Table below.

Table 3-8 Level of achievement with reference to Indicators (Output 4)

Indicators as per PDM (version 1)	Major achievements	Remarks
4-1 Laymanized and professional information are differentiated at PAGASA's website.	● The Project created a mobile website to provide laymanized information. The mobile website is provisionally launched and shall be fully launched before the end of the Project.	● To promote utilization of mobile application and mobile web to provincial level as well.
4-2 Meteorological information is	● In order to reduce concentration of access to PAGASA's website, the Project provided alternative website by	● No other remarks for this indicator.

timely transmitted by PAGASA Central Office to concerned agencies particularly DRRMC	creating above mobile website and mobile application. ● Meteorological information is also transmitted to DRRMC through mobile application mentioned above.	

Source: Interview and Progress Report 3

Output 4 is mostly achieved. In addition to the existing PAGASA website, the Project created a mobile website and mobile application in order to provide laymanized information. Both mobile website and mobile application are launched (though mobile website provisionally launched). One constraint for the Project to modify existing website was that there was an Administrative Order (AO) issued in July 2013 mandating government agencies including PAGASA to migrate to the government web hosting service[4]. By creating alternative websites, the Project intends to reduce the concentration of access by all users into PAGASA's homepage.

Remaining task for Output 4 would be to further promote the utilization of mobile website and mobile application to the public in general.

Output 5: Activities of awareness-raising on meteorological information are improved at Southern Luzon PRSD.

The level of achievements of Output 5 with reference to indicators identified in PDM is shown in the table below.

Table 3-9 Level of achievement with reference to Indicators (Output 5)

Indicators as per PDM (version 1)	Major achievements	Remarks
5-1 Program of awareness-raising is enhanced.	● Awareness raising activities were conducted in 8 elementary schools in the Provinces of Northern Samar, Sorsogon and Southern Luzon. ● Educational materials on typhoon and storm surge for pupils (grades 5/6) was produced in English and was utilized in awareness raising activities in local elementary schools mentioned above. ● Radio Clips (30 sec.) on Bagyo (Tropical Cyclone) and Storm Surge was produced in two local languages: Waray (for Northern Samar Province) and Bikolnon (for Sorsogon Province)	● Indicator 5-1 is achieved, therefore no further remarks for this indicator.
5-2 Result of the implementation of the program is reported.	● The outcomes of the activities are reported to related stakeholders such as Department of Education and the general public in target provinces through local radio stations by airing the radio clips. ● The result of program implementation was also reported to stakeholders at the national level through JCC meetings.	● This indicator does not specify "to whom" the result shall be reported. ● Participation of local DRRMOs on IEC activities has not been sufficient yet.

Source: Interview and Progress Report 3

Output 5 is mostly achieved. Since its first trial awareness-raising seminar in August 2015, the Project

[4] Administrative Order No.30 Mandating Government Agencies to Migrate to the Government Web Hosting Service (GWHS) of the Department of Science and Technology - Information and Communications Technology Office (DOST – ICTO)

conducted two awareness raising seminars in eight (8) elementary schools within the target provinces[5]. The number of attendants was ranging 45-65 elementary school children with 23-50 teachers also participated as observers. The educational materials and video clips mentioned in Table 3-9 are produced by the Project. The digital data of IEC materials will be shared with the Department of Education in target provinces. The radio clips were already made available at local radio stations in Sorsogon and Northern Samar provinces.

3.2.3 Project Purpose

Project Purpose: Capacity of PAGASA Central Office and Southern Luzon PRSD is enhanced in terms of weather observation, forecasting and warning.

The level of achievements of Project Purpose with reference to indicators identified in PDM is shown in the table below.

Table 3-10 Level of achievement with reference to Indicators (Project Purpose)

Indicators as per PDM (version 1)	Major achievement	Remarks
1. Average operation rate (i.e. data are provided to PAGASA from radars) of three radars becomes more than 80% in the third year.	● Average operation rate of Virac Radar is more than 82% during 2015-2016. ● Limited data available for other two sites (Aparri and Guiuan).	● To follow-up average operation rate of other two JRC Radars (in Aparri and Guiuan provinces)
2. Quantitative forecasting is issued by using weather guidance.	● "Automated Production System of temperature guidance" is almost constructed. ● In addition, PAGASA develops the "Forecast work support system" in order to operationalize temperature guidance into its quantitative forecasting based on their plan.	● It is important to steadily complete the "Automated production system of weather guidance" and FxWSS based on the implementation plan agreed between JICA expert and PAGASA counterparts so that PAGASA could enhance quantitative forecasting.
3. More than 80% of concerned actors (i.e. OCD; PCG; LGUs in pilot PRSD) agree that laymanized meteorological information is timely delivered to them in the third year.	● The project aims to deliver laymanized information by developing a mobile application and mobile website. They are just launched in June 2016 and are not sufficiently promoted in provincial level stakeholders. ● Awareness raising teaching materials (such as posters) are produced targeting school children to raise awareness of disaster preparedness and early evacuation.	● The Project will conduct a survey once it is promoted at provincial level to find out the results for indicator 3.

Source: Interview and Progress Report 3

Based on the assessment of level of achievement of indicators, t**he possibility of achieving the Project Purpose by the end of the Project is considered to be relatively high.**

According to the interview with staff from Virac Radar Station, average operation rate already exceeds 80%, while there is no data yet made available for radar stations in Aparri and Guiuan (indicator 1). Radar data are transmitted to PAGASA central office on a real-time basis and the information is also available through

[5] Details of awareness raising seminars can be found in Progress Report 3 produced by the Project.

website. With the advancement of QPE system (Output 2a), the radar data shall be utilized to further improve forecasting and warning.

As for weather guidance, the temperature guidance is developed and it is being incorporated into "automated production system of temperature guidance" (indicator 2). In order to operationalize weather guidance, PAGASA also developed the "Forecast work support system" incorporating temperature guidance. The two systems are expected to be finalized by the end of 2016 and expected to be launched from the beginning of 2017.

It is expected for PAGASA to further develop guidance for other parameters such as rainfall and wind after the end of the Project.

As for indicator 3, the Project launched mobile website and mobile application in order to provide laymanized information. The mobile application was launched in June 2016. The Project is expected to further promote utilization of mobile website and mobile application at the provincial level. It is reported by the Japanese expert that the Project intends to conduct a survey to find out the results for indicator 3 (as per mentioned in Table3-10 above) six months after the launch of mobile application, i.e. in December 2016.

3.3 Implementation Process

3.3.1 Specific arrangements regarding Implementation Process

The following are some issues of importance regarding the implementation process of the Project:

- **Coordination with grant aid project**: The Project is implemented in coordination with JICA's grant aid project, namely "the Project for Improvement of the Meteorological Rader System (2009-2014)". Through this grant aid project, meteorological radar systems were installed in three provinces in Virac, Aparri and Guiuan Provinces.
- **Implementation structure**: Japanese experts were dispatched based on two different kinds of contract. Chief advisor and project coordinator were dispatched under direct administration of JICA, while short-term experts team were dispatched from a Japanese consultancy company on a contract basis.
- **Formation of technical working groups (TWG)**: Seven TWGs were formed under 5 Outputs of the Project~~,~~ namely: i) Radar maintenance (Output1a), ii) Meteorological Instruments and weather observation (Output1b), iii) Quantitative Precipitation Estimation (QPE)(Output 2a), iv) Weather guidance (Output 2b), v) ARG (Output 3), vi) mobile application/website (Output 4), and vii) awareness raising (Output 5).

3.3.2 Promoting Factors for the Realization of the Project's Effects

The following are factors promoting the realization of the Project effects:

- **Commitment of TWG and counterpart members**: Most of the TWG members interviewed during the evaluation study are involved from the beginning until at the time of the terminal evaluation without being affected by rotation of human resources in PAGASA. The continuous cooperation and commitment of TWG members and counterpart members are promoting factors during the Project implementation that

facilitate the achievements of activities and outputs identified and expected of the project, respectively.

- **Modernization Act of PAGASA**: "The PAGASA Modernization Act" which took effect in 2015 to improve PAGASA's technological operation capacity. Objectives stated in the Modernization Act include providing useful, timely, accurate and reliable weather, forecasting and localized warning, which are consistent with the objectives of the Project. It is expected that the outcomes of the Project will be further reinforced with effective implementation of the Modernization Act.

3.3.3 Inhibiting Factors for the Realization of the Project's Effects

The following are inhibiting factors for the realization of the Project effects:

- **Absence of data to set up QPE and criteria for warning**: Utilization of rainfall data from AWS/ARG is indispensable for development of QPE system and also for setting up criteria for warning. In order to reinforce data collection, the Project installed 9 ARGs in July 2016. However the amount of rainfall data so far is not sufficient to complete Output 2a (QPE) and Output 3 (Warning criteria) within the Project implementation time.
- **Insufficient archive of disaster record at the provincial and local level**: Rainfall-related disaster record is also necessary to set up criteria for warning (Output 3). Archive of disaster record is managed by NDRRMC and summarized data are also made available through OCD website. However, archive of detailed natural disaster data induced by rainfall at the local level is also necessary in order to set up criteria for warning at the local level[6].
- **Provision of laymanized information through website**: The Project did not modify existing PAGASA website due to a limitation set by an Administrative Order in July 2013 mandating all government agencies to migrate to the government web hosting service. The Project instead developed mobile application and mobile website in order to provide laymanized information. Since the launch of mobile application in 2016, mobile application and mobile website are not yet widely promoted throughout the country, therefore their contribution for reducing access to existing PAGASA website is not yet clear.
- **Risk factor for sustained activities of QPE and Weather Guidance**: It is discussed during the focus group interviews with TWG members that some of the tasks implemented by the Project are conducted as additional activities on top of their regular tasks as PAGASA employees. These tasks include: QPE and Weather guidance. The evaluation team notes that there are certain risk factors for the continuation of these activities after the end of the Project.
- The interaction time between Japanese experts and PAGASA C/Ps for technology transfer is limited. Based on the project design, Japanese experts are dispatched on short-term basis only. On the other hand, PAGASA C/Ps could only devote 30-50% of their time for the Project activities because of other tasks assigned to them as PAGASA employees.

[6] According to the interview with JICA experts, it is reported that in Albay province natural disaster data is only archived only during two to three years.

4. EVALUATION RESULTS BY FIVE EVALUATION CRITERIA

4.1 Relevance

The relevance of the Project is high for the following reasons:

- The Project design is in line with national policies of the Philippines namely, the "Philippine Development Plan (2011-2016)" which states the strategy to enhance monitoring, forecast, early warning and risk assessment and risk management system. The Philippine's Disaster Risk Reduction and Management Act was established in 2010, whose objectives include "early warning" and "awareness raising".
- The Project is consistent with priority areas for Japan's Assistance Strategy to The Philippines. The Project is conducted under the development issue of "Disaster Risk Mitigation and Management" of the priority area "Overcoming Vulnerability and Stabilizing Bases for Human Life and Production Activity" of the Japanese Government's Country Assistance Strategy for the Philippines (2012).
- Southern Luzon region, as the target area of the Project, is one of the typhoon-prone areas. It also hosts one meteorological radar stations installed by Japan's grant aid project. This Project aims to reinforce operation and maintenance side of the Radar stations as part of its five components.

4.2 Effectiveness

The effectiveness of the Project is considered to be relatively high for the following reasons:

- The possibility of achieving the Project Purpose by the end of the Project is considered to be relatively high.
- The Project expects to issue quantitative forecasting (Indicator 2 of Project Purpose) by utilizing temperature guidance before the end of the Project. For further enhancement of the quantitative forecasting, it is expected for PAGASA to continue development of weather guidance for other parameters such as rainfall and wind after the end of the Project.
- The Project aims to provide timely laymanized meteorological information (Indicator 3 of Project Purpose) to all stakeholders (including OCD; PCG; LGUs in pilot PRSD) by developing a new mobile application and mobile website. They are launched in June 2016, although they are not widely recognized yet among stakeholders especially at the Provincial level.
- The effectiveness of the Project could be enhanced if indicator 2 and 3 mentioned above are achieved before the end of the Project.

4.3 Efficiency

Overall, the level of efficiency of the Project is considered to be moderately high for the following reasons:

- The Project is designed to efficiently utilize meteorological radar stations installed by Japan's grant aid project. Just after the completion of the grant aid project in 2014, the Project initiates in 2014 to reinforce operation and maintenance of radars as well as to effectively utilize radar data for improvement of weather observation, forecasting and warning.
- Consistent involvement of TWG members and PAGASA counterparts throughout the Project cooperation period is expected to enhance the efficient implementation of the Project.

4.4 Impact

Impact is a viewpoint that asks "whether expected or unexpected long-term effects are brought about as a result of the Project". Overall Goal, which is expected to be achieved within three to five years after the Project completion, is one of the expected impacts of the Project.

As for the achievement of Overall Goal "Capacity of all PRSDs is enhanced in terms of weather observation, forecasting and warning", the Evaluation Team considers that the probability of achieving the mentioned Overall Goal within three to five years is moderate. The main target of the Project is PAGASA central office and SL-PRSD, and there are more steps necessary for substantial capacity enhancement in other PRSDs. PAGASA as main counterpart of the Project is expected to play an important role to disseminate knowledge and experiences gained throughout the Project to all PRSDs in terms of observation, forecasting and warning.

The laymanized meteorological information (indicator 1 of Overall Goal) is practically available for all PRSDs through mobile application and mobile website, as well as existing PAGASA website. Level of achievement of Overall Goal could be further enhanced if PAGASA promotes the utilization of mobile application and mobile website not only within NCR and South Luzon, but also in all other non-pilot PRSDs.

No negative impacts have been identified so far.

4.5 Sustainability

The sustainability of the Project is considered to be moderately high for the following reasons:

- Policy aspect: National level policy such as "PAGASA Modernization Act in 2015" and "Philippine Disaster Risk Reduction and Management Act in 2010" shows that the Project's objectives are also part of the priority area.
- Institutional and financial aspect: Five (5) out of seven (7) TWGs implement their task as part of regular work as PAGASA (i.e. TWG on Output 1a, 1b, 3, 4, 5), therefore institutional and financial sustainability is relatively high for these activities. The remaining two (2) TWGs, i.e. TWG on Output 2a (QPE) and Output 2b (weather guidance) implement their project tasks on top of their regular work as PAGASA employees, so some framework would be necessary for these TWGs to continue achieving further project outcomes.
- Technical aspects: Different aspects of technical transfer have been carried out for the enhancement of weather observation, forecasting and warning for staff members of PAGASA, SL-PRSD and Synop/AWS in the region, as well as in radar stations in three provinces. Knowledge and experiences are shared to enhance operation and maintenance of radar and meteorological instruments, development or utilization of various software, research and development such as QPE and weather guidance, to name a few.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The Project is making good progress. Regarding level of achievements, both Outputs 1&2 are considered to be moderately achieved, Output 3 is partly achieved and Output 4 & 5 are mostly achieved. The possibility of achieving the Project Purpose by the end of the Project (May 2017) is considered to be relatively high. In light of indicators for the Project Purpose, the achievement of the Project Purpose is subject to the development of i) Quantitative forecasting issued by using weather guidance (indicator 2) and ii) laymanized meteorological information being delivered timely to concerned actors including SL-PRSD and LGUs (indicator 3).The remaining tasks before the end of the Project is indicated in "Remarks" of above summary Tables (Tables 3-5 to table 3-10).

In terms of five evaluation criteria, relevance is considered to be high. Effectiveness, efficiency and sustainability of the Project are considered to be moderately high. The impact, which is a viewpoint to assess the possibility of achieving the Overall Goal is considered to be moderate. However the impact of the Project could be enhanced if PAGASA continues to disseminate knowledge and experiences gained throughout the Project in terms of observation, forecasting and warning to all PRSDs after the end of the Project.

5.2 Recommendations

On the basis of the results of the study summarized above, the Terminal Evaluation Team has made the following recommendations to the Project.

5.2.1 Recommendations to be considered during the Project period (until May 2017)

1. For traceability of meteorological instruments (indicator 1-1 of Output 1), the Project mainly focused on improvement of atmospheric pressure. The Project also compared existing reference standard for thermometer with JMA's travelling standard. In order to operationalize traceability at the local level, it is advised for RDTD to coordinate with ETSD to assure that the calibrated instrument is utilized at the local level after installation. At the same time, it is important to educate staff members at local Synop/AWS stations for the importance of utilizing newly installed instruments. It is also recommended to discuss importance of Quality Control (QC) to assure (traceability) accuracy of meteorological instruments.
2. To follow up if the monthly maintenance reports including equipment status report at radar sites are regularly reported to ETSD. At the same time, it is advised to assure if equipment status reports of other meteorological instruments are regularly reported to ETSD as is instructed in MASSO.
3. For early development of QPE system and setting up criteria for warning, it is necessary to archive precipitation data from radar stations and ARG/AWS. A workshop on the assessment of warning criteria and development of new threshold values is recommended when more data has been collected.
4. For future development of precipitation guidance, it is necessary to assure archive of precipitation data (ARG/AWS).
5. The Project is advised to steadily complete the "Automation Production System of Weather Guidance" and to launch the operation of "Forecast work support system (FxWSS)".
6. For warning criteria in SL-PRSD, it is advised to i) operationalize the warning criteria set in Legaspi and evaluate, ii) to assess whether the provisional warning criteria is also applicable to ARG sites, by comparing precipitation data and disaster data (such as flood).
7. Regarding the elevation angle of radars, it is suggested to JICA expert in charge of QPE to write a letter to WD to propose modification of the elevation angle of three JRC radars. It is important for observation

of not only typhoons but also rain clouds.

8. It is recommended to promote mobile application and mobile website not only to NCR but also provinces. It is recommended that local DRRMOs be involved in IEC activities as member of TWG to complement resources of the Project.

5.2.2 Recommendations to be considered after the completion of the Project

1. For improvement of traceability, it is necessary to assure traceability for raingauge and anemometer as well.
2. For a continuous development, operation and improvement of weather guidance, it is fundamental to allocate technical staff who are exclusively in charge of development and operation of automated production system of weather guidance.
3. For development of QPE system and warning criteria, it is necessary to archive all precipitation data and radar data. Towards this end, it is advised to establish a data management structure within PAGASA to follow up when the radar data and/or precipitation data is not appropriately transmitted.
4. Based on the proposal letter to be submitted by JICA expert, it is recommended to PAGASA to further examine re-arrangement of observation angle mode of three JRC radars (in Virac, Aparri and Guiuan Provinces), as well as to establish a quality control (QC) systems of Radar data. Necessary actions shall be taken accordingly.
5. For establishment of warning criteria at the provincial level, it is necessary to archive natural disaster data induced by rainfall at the local level. For this purpose, it is recommended to strengthen coordination with local level entities such as PDRRMOs to efficiently utilise and reflect local level natural disaster data induced by rainfall into warning criteria.

5.3 Lessons Learned

In the process of implementation of the Project, good practices and lessons learnt were identified as follows:

- Baseline study conducted at the earlier stage of the Project is an important chance to modify indicators of PDM by clarifying goals and targets of the Project.
- Automation of system, once it is established, requires technical support structure in order to continuously operate, review, and update the system
- When the Project implement new activities that are not part of the regular tasks within the counterpart agency, it is important for the Project to discuss and clarify the continuity of these activities after the Project within the Project cooperation period.