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Research Article

Activities of JICA on disaster prevention and achievement of JICA project in Period 1

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Abstract: The Japan International Cooperation Agency (JICA) has supported various natural disaster prevention activities in Vietnam in accordance with the "Sendai Framework for Disaster Risk Reduction 2015–2030". From 2007 to 2017, around 90 percent of the total damages in Vietnam were accounted by water–related natural disasters. JICA implemented several grants and technical cooperation programs for reducing water–related disaster risks, and as a part of these activities, the "Project for Strengthening Capacity in Weather Forecasting and Flood Early Warning System" by the Vietnam Meteorological and Hydrological Administration (VNMHA) and JICA started in May 2018 as a 3.5 year project. In the Period 1 (June 2018 to March 2019), Automatic Weather Station (AWS) inspection and maintenance manuals were prepared and through trainings at Phu Lien and Vinh radar sites, practical radar maintenance knowledges were shared. Fifteen Automatic Rain Gauges (ARGs) were newly installed in Phu Lien and Vinh radar areas and radar composition started to cover whole Vietnam. For weather forecasting, temperature guidance for 63 cities by the Kalman Filter was developed, and precipitation products based on satellites were evaluated. Discussion on improvement of short–range precipitation forecasting up to 15 hours ahead also started.

Keywords: JICA; Disaster risk reduction; International cooperation; Meteorological observation; Forecasting.

1. Activities of JICA on disaster prevention

The Japan International Cooperation Agency (JICA) has supported various natural disaster prevention activities in Vietnam. Every year natural disasters occur frequently in Vietnam, and more than 100 people of deaths and missing are recorded. In 2019, 133 people were dead or missing, and the damage by natural disasters cost 304 million USD [1]. Floods and landslides caused by heavy rains and storms dominate in Vietnam. According to the record of deaths, missing and damages by natural disasters from 2007–2017, around 90

percent of the total damages were accounted by water–related natural disasters such as storms, floods, flashfloods, or landslides [2]. Other natural disasters such as coastal erosion, drought, salt damage, etc. also occur and suffer the land. According to the Law on Natural Disaster Prevention and Control (No:33/2013/QH13), 19 types of disasters are prescribed in the article 3: typhoon, tropical depression, whirlwind, lightning, heavy rain, flood, flashflood, inundation, landslide and land subsidence due to floods or water currents, water rise, salt intrusion, heat wave, drought, damaging coldness, hail, hoarfrost, earthquake, tsunami and other types of natural disaster. Adding snow damage and forest fires, the Vietnamese government copes with 21 natural disasters [3].

Although 133 of deaths and missing in 2019 are the lowest since 2014 and the damage cost decreased by 67% compared to 2018, Vietnam has suffered from great disasters in its history. For example, Typhoon Linda, which hit the Mekong Delta in November 1997, capsized many fishery boats, and brought great damage to coastal villages. This typhoon caused more than 3,000 deaths and missing people.

In November 1999, due to heavy rain in the central region, 2,500mm of precipitation was recorded at Thua Thien Hue Province and caused severe flood widely in the central region. This caused 567 deaths and missing and 66,038 ha of paddy fields were flooded and damaged. In recent years, several typhoons hit Vietnam in 2017 and heavy rain caused flood and landslide in central and northern areas. The disaster damage cost in 2017 was counted as 2,641 million USD, which is the largest in 30 years.

In 2019, flashflood hit Thanh Hoa Province in August, and severe flood occurred in Phu Quoc Island in Kien Giang Province in August and Vinh City in Nghe An Province in October.

In order to strengthen the capacity to cope with natural disasters in Vietnam, JICA has supported various activities in accordance with the “Sendai Framework for Disaster Risk Reduction 2015–2030” and the “2030 Agenda for Sustainable Development (SDGs)”. Especially, JICA emphasizes the importance of efforts for Disaster Risk Reduction (DRR) and puts the highest priority on prevention and mitigation, and encourages “disaster risk reduction investment to improve resilience”. For the achievement of DRR, promoting for understanding of disaster risks, pre–investment for disaster prevention, Build Back Better (BBB) concept are also important as well as formulating DRR plan at local level. Therefore, JICA takes an approach to support formulating regional disaster prevention plan in local by the following eight steps:

Step1. Collecting local hazard information

Step2. Understanding local disaster risks

Step3. Confirming DRR plans by national and other authorities

Step4. Identifying residual risks considering time–series

Step5. Listing all necessary DRR measures by local governments

Step6. The One–Year–Old

Step7. Arranging budget allocation in necessary levels

Step8. Implementing DRR measures and reviewing periodically

The recent increase of natural disasters gives us some concern that climate change would affect more severely and harshly in Vietnam with heavier rainfall and more powerful typhoons. In addition, the rise of sea level would detain smooth river flow into the ocean and it can result in flooding in wider areas.

For these reasons, JICA understands it is necessary to support sustainable investment in disaster prevention as climate change adaptation. For example, JICA supported the Vietnam Disaster Management Authority (MARD) to develop “Priority Programs for Disaster Risk Reduction in Vietnam” in 2018. In the programs a goal was set as establishment of disaster resilient society aiming at socioeconomic development, and six priority programs were

identified to strengthen investment in DRR in Vietnam in accordance with Sendai Framework.

As for strengthening DRR management in river, a grant aid project, "Emergency Reservoir Operation and Flood Effective Management Using Water Disaster Related Management Information System", was signed between MARD and JICA in 2017. This project focuses on establishment of an X–band radar rainfall observation equipment, water level gauges, and gate opening meters for dam in the Huong River basin to install the real–time observation network. In addition, CCTV cameras are utilized to monitor visually the downstream of the Huong river. These observed data are integrated into the information system and utilized for optimizing the operation of dams and monitoring the condition of river flow during the time of flooding.

In addition, in response to the frequent occurrence of flashfloods and landslides in the northern part of Vietnam in recent years, JICA's basic surveys have been carrying out to understand the risk of flashflood and landslide and to find out appropriate countermeasures in these areas from December 2019. During the survey, the JICA survey team will conduct on–site surveys where flashflood and landslide disasters occurred in the past in Yen Bai and Son La provinces, and investigate current situation and issues to be solved.

2. National Meteorological and Hydrological Services and Disaster Risk Reduction

The World Meteorological Organization (WMO) assists National Meteorological and Hydrological Services (NHMS), especially those of developing and least developed countries, in their efforts to contribute in the most effective manner to the national development and to become full partners in global collaborative efforts, especially when it pertains to:

- ✓ Protection of life and property
- ✓ Safeguarding the environment
- ✓ Contributing to sustainable development
- ✓ Promoting long–term observation and collection of meteorological, hydrological and climatological data, including related environmental data

NMHS covers observation, forecast, data communication, forecast/warning dissemination and so on, and has to be responsible for various scientific and technical fields to provide reliable meteorological information to the public [4].

Almost every NMHS has approximately the same meteorological service operation system such as (1) observation of meteorological phenomena, (2) obtaining domestic and international meteorological information, (3) data analysis, (4) weather forecasting and (5) dissemination of meteorological information to related organization and the public.

However, the contents of an operation system in each field such as from meteorological observation to dissemination of meteorological information has some differences in detail among NMHSs. These differences depend on the context of each country including the capacity of staff members and infrastructures of NMHS, and these situation gives influences in the quality of the final products of each NMHS.

NMHS in many developing countries recognize that they have problems or issues to be solved for better quality in the field such as (1) to (5) mentioned above. However, in many cases, they have difficulties to take concrete countermeasures against these problems or issues due to many circumstances.

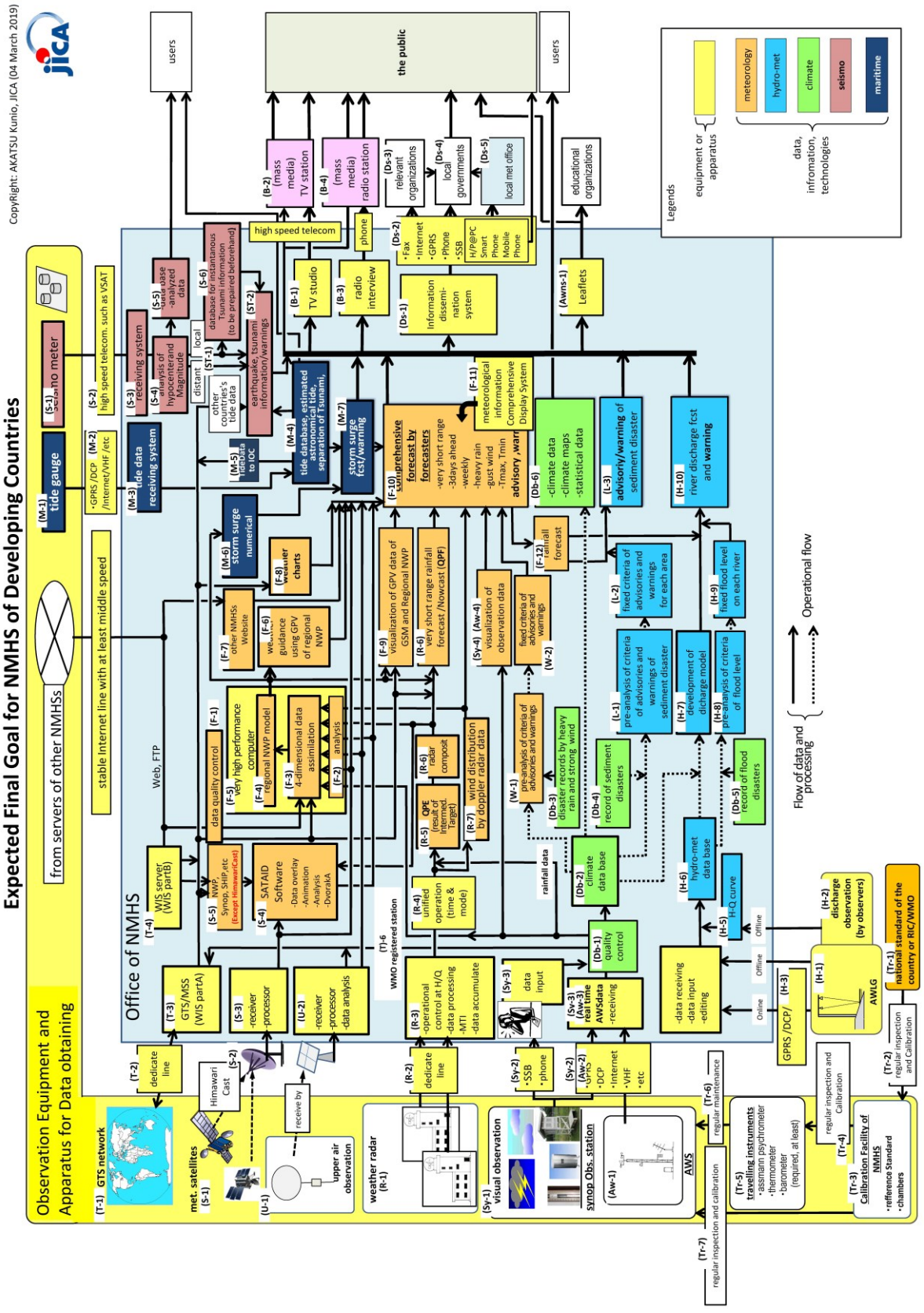

Figure 1. Expected Final Goal (AkatsuChart).

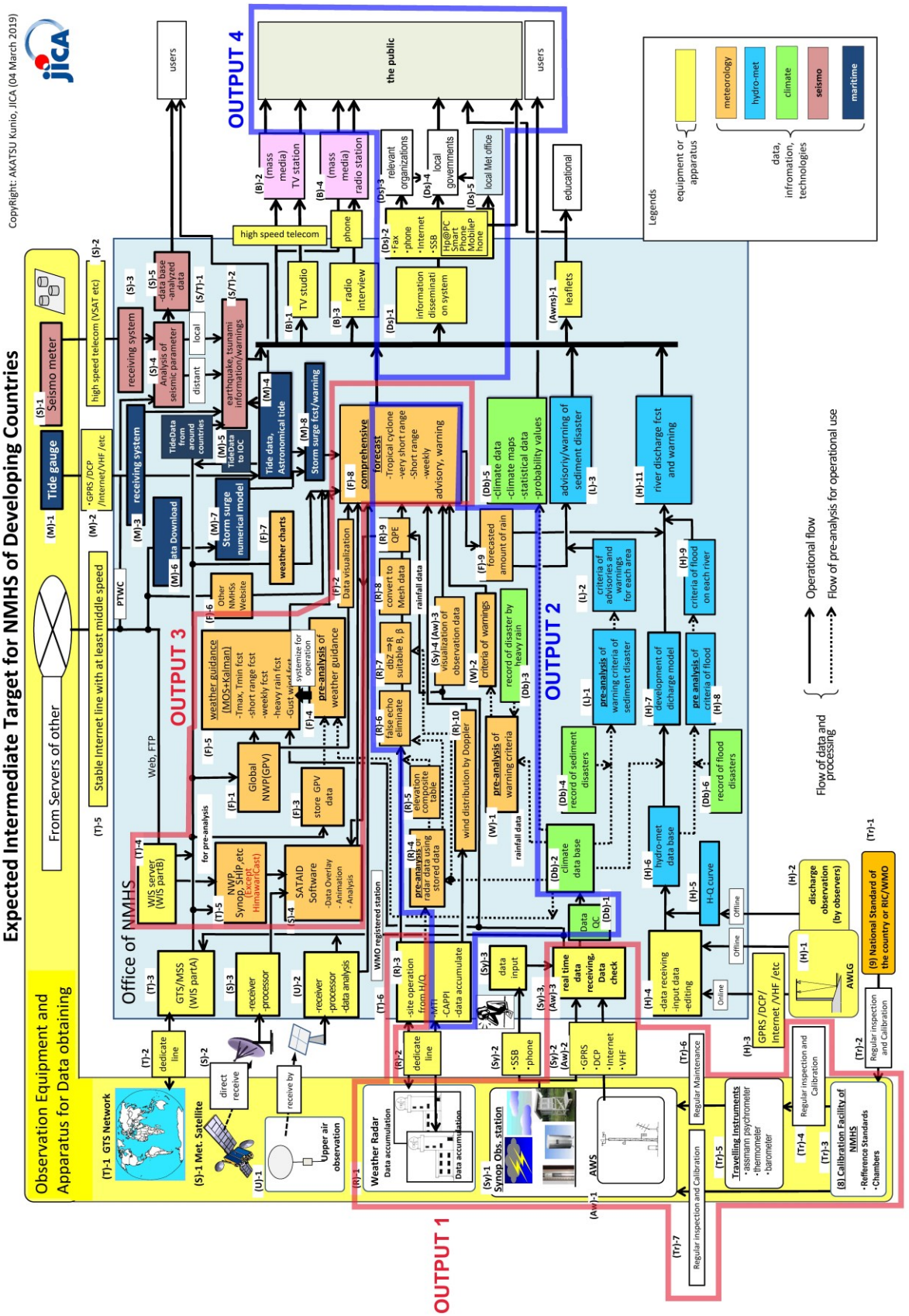

Figure 2. Expected Intermediate Target (AkatsuChart).

JICA has created the schematic charts which indicate the specific contents and concrete methods of every meteorological field (from observation to information dissemination) and total data flow network to be prepared among various fields of each NMHS (Figures 1–2).

Useful characteristics of these charts are that (1) it shows total operation system or data network required in every NMHS as birds–eye view, (2) every staff member of NMHSs can understand their duties or responsibilities clearly for total activities required to NMHSs and (3) everybody easily understands the order of priority fields to be improved in NMHSs. The charts are called as "AkatsuChart" among many developing NMHSs including international donors.

AkatsuCharts consist of 2 (two) versions, one is titled as "Expected Final Goal" and another is titled as "Expected Intermediate Target". The "Final Goal" chart (Figure 1) includes themes which seem difficult to be prepared for developing NMHSs, then the "Intermediate Target" chart (Figure 2) is designed to show expected achievements for every developing NMHSs. Items enclosed in rectangular box in the chart correspond to each "Activities" of the Project Design Matrix (PDM) which shows details of targets of JICA projects.

When JICA plans to prepare new meteorological project in some countries, JICA implements a preliminary survey composed of the JICA officials including JICA Senior Technical Advisor. AkatsuChart is utilized in the survey in the following manners. (1) JICA officials carry out a preliminary survey on outline of the operation situation of NMHS, (2) JICA explains JICA's recommendable future plans such as Final Goal and Intermediate Target by using AkatsuChart, (3) JICA explains the results on outline of preliminary survey and shows issues or challenges of each field, (4) discussions between NMHS and JICA are held on the issues or challenges, (5) finally, the results of discussions are summarized and these are utilized for JICA official project.

Through taking these processes, structures and components of the project (what, why, how) are clarified and gaps of understanding between both sides can be avoidable, furthermore the theme for next step–up after the project will be visualized. Additionally, by using AkatsuChart, the chart of standard developing model for technical support, JICA can avoid the occurrence of gaps of directivity among technical cooperation projects for NHMSs and JICA supports.

Vietnam is a vulnerable country against natural disasters and suffers from damages by high impact weather events. Therefore, enhancement of meteorological capacity/skill for more accurate information and for adequate dissemination are strongly required. Vietnam and Japan exchanged an agreement on "Programme for the Improvement of Capabilities to cope with Natural Disasters Caused by Climate Change" on 30th of June, 2010 and Vietnam requested the "Project for Strengthening Capacity in Weather Forecasting and Flood early warning system".

JICA implemented the Detailed Design Survey for the request from 8th to 23rd of June 2017. JICA experts visited the Vietnam Meteorological and Hydrological Administration (VNMHA), implemented assessment of VNMHA observation/forecasting/dissemination services, including North central Regional Hydro–Meteorological Center. Based on results of detailed design survey the both sides discussed details of the project with, referring Akatsu Charts and results were summarized as the Project Design Matrix (PDM) and the Plan of Operation (PO), and the Both sides exchanged the Record of Discussion (R/D) for the project for enhancement of capacity in weather forecasting and flood early warning system on 17th of November 2017.

As a part of JICA cooperation for DRR activities, a technical cooperation project "Project for Strengthening Capacity in Weather Forecasting and Flood Early Warning System" (hereafter, described as 'the Project') was started in June 2018 as a part of JICA

activities and enhancing NMHS abilities for disaster risk reduction. Scopes of activities for each output 1 to 4 of the VNMHS project are overlaid on Figure 2.

3. Project Design and Operation Plan

This project is designed to strengthen capacity for (1) maintenance and traceability of meteorological observation equipment, (2) analysis and quality control ability for radar, (3) forecasting/warning ability regarding heavy rain and typhoon and (4) dissemination ability of meteorological information. Through enhancing these abilities, more accurate meteorological information should be provided to related agencies and to the public and meteorological/hydrological information from VNMHA would contribute to disaster prevention activities by related agencies and the people.

On the PDM of the project, the outline is described as follows,

=Overall Goal=

Weather information disseminated from VNMHA is well utilized by the public and disaster related organizations.

=Project Purpose=

More accurate and timely meteorological information is disseminated to the public and the disaster related organizations.

=Output=

Output1: Capacity on maintenance and calibration of ground meteorological observation equipment is improved.

Output2: Capacity on weather observation, radar data analysis and quality management are improved.

Output3: Capacity on monitoring and forecasting of heavy rainfall and typhoon is improved.

Output4: Quality, contents and accessibility of Regional weather forecasts in North East (Phu Lien) and North Central (Vinh) are improved.

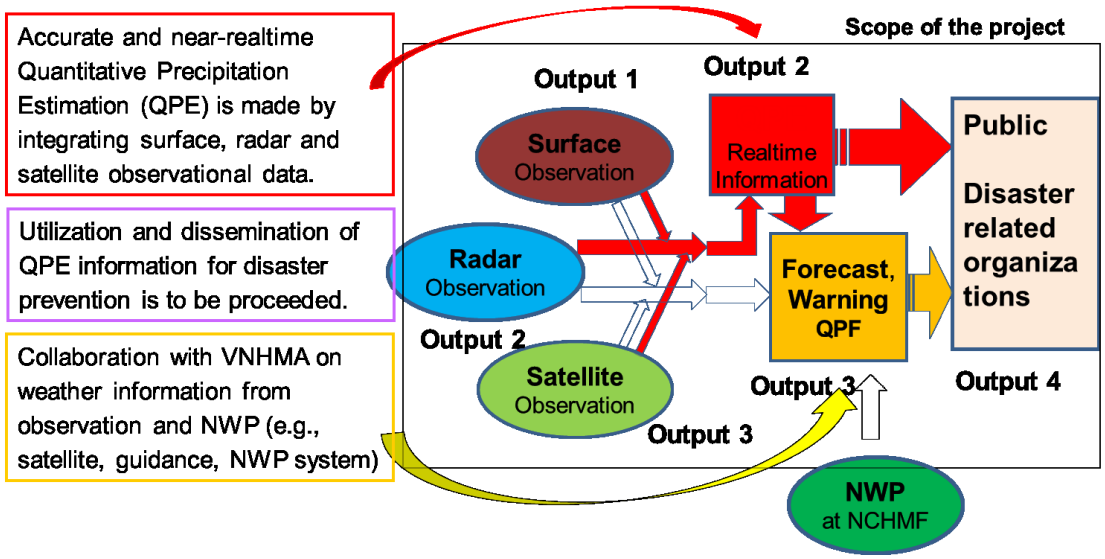

Figure 3. Structure of the project.

The project is designed as a 3.5 year project and is divided into periods, Period 1 (May 2018 to March 2020) and Period 2 (April 2020 to October 2021) shown in Figure 4. For the implementation of the project, Technical Working Groups are organized for each output and Working Group (WG) member, several officers from VNMHA and JICA experts, are assigned and project activities are mainly implemented and lead by these WGs.

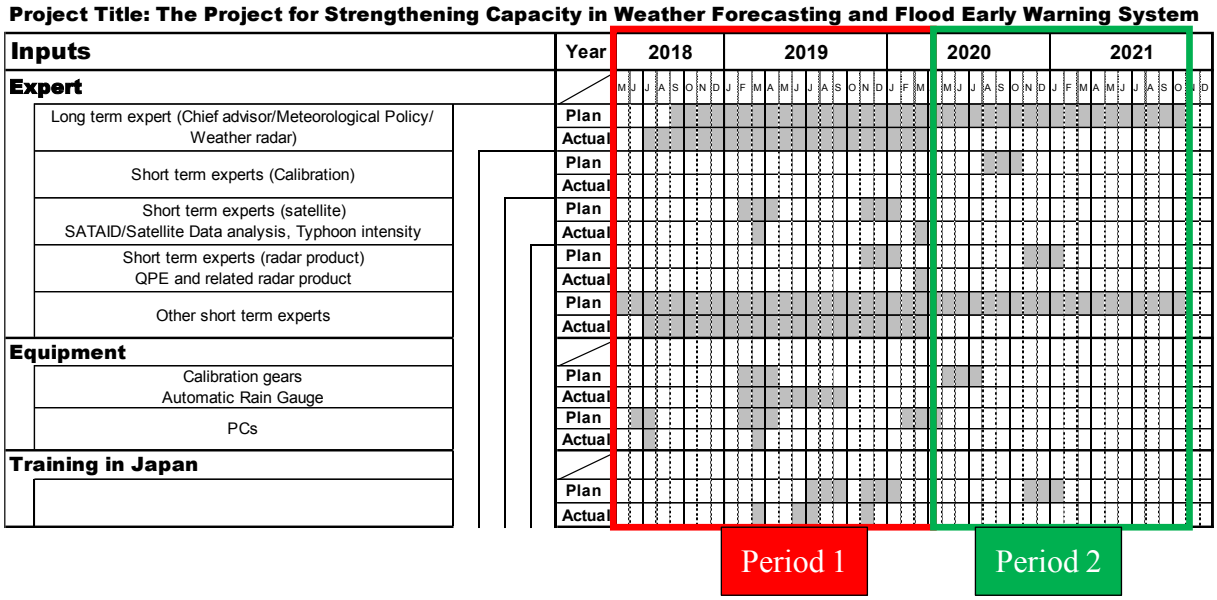

Figure 4. Project operation chart.

4. Summary of Activities in Period 1

As shown in Figure 3, the project consists of four outputs, namely Output1 (observation), Output2 (radar), Output3 (forecasting) and Output 4 (dissemination). The project is reviewed by the Joint Coordination Committee (JCC) held in every six months and VNMHA and JICA discussed matters, countermeasures and activity plans. Besides activities on the four outputs, the project was held on site special trainings/seminars by (former) Japan Meteorological Agency (JMA) experts for one week on satellite usage (March 2019), radar product and advanced satellite usage (March 2020) respectively. Activities during Period 1 are summarised as follows.

4.1. Output 1 (observation)

In VNMHA, traceability and maintenance of surface observation instruments are handled by the Hydrological Meteorology and Environment Observation Station Network Center, and for evaluation of instrument accuracy periodical calibration is also carried out. In the Synop manned observation, almost common equipments are used, but Automatic Weather Stations (AWSs) use different equipments by donors, and instruments were calibrated by the Headquarters at the time of shipment to districts. At present, there are 338 AWSs and 74 anemometers, and the development plan states that VNMHA will shift from manned observation (Synop) to automatic observation by AWS. For the calibration/maintenance of AWSs, WG drafted AWS inspection and a maintenance manual and based on the manual, WG carried out AWS maintenance at six AWS (three in Vinh region and three in Hai Phong region) sites.

For maintenance of radars, WG confirmed that daily/monthly maintenance has been implemented by Phu Lien and Vinh staff members continuously and recorded on maintenance reports. JICA experts attended JRC maintenance activities in September 2018 and shared information with JRC engineers, Phu Lien and Vinh radar staff members. Additionally, on site trainings at Phu Lien and Vinh radar sites, “maintenance of tower and radome”, “electric power supply”, “inspection of transmitter”, “inspection of DRSP”, “measurement of an antenna angle accuracy”, “training of measurement equipment”, “lectures of trouble shooting” and so on, were implemented in November to December 2018. And annual maintenances at Phu Lien and Vinh radar sites were implemented from May

2019 with experts and partly with a JRC local staff member. Additionally, scan angles for Phu Lien and Vinh radar were discussed a plan of new scan sequence was proposed. The details of Output 1 activities are given by [5].

4.2. Output 2 (radar)

JMA implements an international project "South–east Asia radar composite program" based on the WMO–WIGOS (WMO Integrated Global Observing System) project. So far, JMA shared a radar Quality Control/ Quantitative Precipitation Estimate (QC/QPE) package to NMHSs of Thailand, Malaysia and Indonesia and supported radar composition in these countries. VNMHA requested JMA to share the package and JMA implemented trainings for VNMHA trainees (two trainees) to explain the package in Japan in May 2019.

The shared JMA QC/QPE package was installed to a PC server set in AMO. The QC/QPE package was modified to VNMHA radars: at first Phu Lien, Vinh (JRC), and then Tam Ky, Dong Ha, Nha Be (Single–polarization radar, Vaisala), Pha Din, Pleiku, Quy Nhon (Dual–polarization radar, Vaisala) were calibrated with AWS data in May and June 2019. An experimental composition and QPE started in the PC server from September 2019 and WG confirmed composite radar data were overlay on cloud images using SATAID, a satellite data visualization and manipulation system developed by JMA. The radar composite techniques for Vaisala and JRC radars were improved, i.e. improvement of QPE processes (PPI composition tables, exact site location of radar/AWS), and lectures for QPE process and programs were implemented in November 2019. Modified QPE package to avoid over calibration by far rain gauges were corrected and adapted in February 2020. A detailed description on PQE conducted in Output 2 is given by [6].

4.3. Output 3 (forecast)

For development of temperature guidance, WG carried out verification of maximum and minimum temperatures of city forecasts for 63 major cities issued by VNMHA and Kalman filter (KF) guidance with JMA's global model data (GMS–KF guidance), and confirmed KF guidance mostly showed more accurate results than NWP itself and operational city forecasts. Based on the results, WG started an experimental operation of KF guidance for 63 cities up to 3 days ahead. In December 2019, WG developed another KF guidance, based on the ECMWF's global model (IFS) data up to 9 days ahead using 00UTC and 12 UTC initial grid point values (GPVs) and conducted a trial operation of it [7].

VNMHA had temporary used a relationship between cloud top temperature (TBB) and rain amount [8] to estimate rainfall amount from satellite data. Since the heavy rainfall event in December 2018 was not brought by deep convection but by the warm rain process, rainfall intensity around central Vietnam was significantly underestimated. To improve the precipitation analysis, WG examined GSMaP rainfall produced by JAXA EORC [9], i.e. standard product (GSMaP_MVK; 3–hours delay) and real–time product (GSMaP_NOW; updated every half hour by extrapolation using cloud motion vectors). Threat scores of GSMaP_MVK are apparently better than GSMaP_NOW and rain estimation using TBB [10]. VNMHA started operational use of GSMaP data for their precipitation analysis in October 2019 [11].

Additionally, Training on utilization of satellite, radar and GPV data for monitoring heavy rainfall was provided. Post–analyses of heavy rain events including tropical cyclones in 2018 were carried out. Presentation/Practice for "weather guidance" and "case study analysis for heavy rain" at the regional forecasting centers were implemented in July and followed–up in November 2019.

4.4. Output 4 (dissemination)

Questionnaires to grasp customer needs were prepared and distributed to municipal disaster prevention authorities, the People's Committee, mass media and related private sectors in June 2018. On–site interviews to forecasters were conducted and copies of forecast manual/warning logs were collected in the North East Regional Center in December 2018.

Pre–site surveys (for 20 candidate rain gauge sites) were implemented to decide appropriate sites for Automatic Rain Gauge (ARG) installation for radar data calibration in Phu Lien and Vinh areas. Based on the survey result, 18 sites were recommended for ARG installation in 2018. Basement and stand for Fifteen ARG systems were set in April and May 2019. 15 ARG system were transported, calibrated and set in 15 sites in September and October 2019, data collection and monitoring were started from the middle of October 2019.

5. Conclusion and Suggestion (for Activities in Period 2)

During Period 1, the project concentrated to enhance abilities of VNMHA for observations and forecasts and achieved various outputs, however, in Period 2, the project aims to disseminate weather products aggressively and utilize them for DRR activities. In Period 2, the project targets further technical skill developments of VNMHA and WG tackles to weather information dissemination and utilization.

For Output 1, activities for maintaining AWS equipment and traceability are scheduled. Regarding radar maintenance, maintenance activities at sites have been steadily implemented and annual maintenance works by AMO also have been implemented regularly. Though, there remain outstanding matters, (i) radar maintenance contract with manufacturers for further stable operation, (ii) preparation of spare parts for AWS and (iii) quality check of AWS observation data.

For Output 2, radar composition products, not only for JRC radars but for those covering whole Vietnam country were succeeded and QPE using composite radar and AWS data experimentally started. However, for accurate and reliable QPE, there remain lots of matters to be tackled, i.e. modification of scan angles, improvement of composite table, quality check/control of AWS data, evaluation of QPE and improvement of QPE based on these activities. Additional next challenges are usage of doppler velocity, trial to Quantitative Precipitation Forecast (QPF).

For Output 3, Kalman–filter temperature guidance developed for major cities, could be used operationally, however, guidance for precipitation and improvement of numerical weather prediction, with VNHMA's great expectations, are under discussion through investigating and discussion by VNMHA and JICA. These terms are one of the most important targets in Period 2.

For Output 4, transportation of procurement items for calibration gears and three additional AWSs started in May 2020. WG would tackle for improvement of web site and dissemination of weather products.

For developing more accurate and timely meteorological information, VNMHA and JICA continuously challenges to clear matters step by step steadily. And meteorological information developed through the project will be disseminated aggressively mainly through mobile web sites to achieve the project purpose.

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