

Country Name	Project for Capacity Development of GLOF and Rainstorm Flood Forecasting and Early Warning
Kingdom of Bhutan	

I. Project Outline

Background	Bhutan was experiencing an increase in the number of disasters related to hydro-meteorological hazards, such as flash floods and rainstorms, which had not been observed before. Since 1960s, a number of glacial lake outburst floods (GLOFs) had been recorded concurrently with shrink of glaciers and expansion of glacial lakes due to the effects of climate change. The preceding JICA/Japan Science and Technology (JST)'s project ("Study on GLOFs in the Bhutan Himalayas" (2009-2012)) assessed GLOF risks in the Mangdechhu basin and recommended continuous monitoring of the glacial lakes and development of early warning system (EWS). However, capacity of Department of Hydro-met Service (DHMS) under Ministry of Economic Affairs for flood and GLOF forecasting and monitoring was limited. Emergency response capacity of other stakeholders was also insufficient.				
Objectives of the Project	<p>The project aimed to enhance capacity of DHMS and relevant stakeholders on emergency response against GLOF/rainstorm flood in Bhutan through (i) enhancement of capacity of related agencies on GLOF/rainstorm flood risk assessment, development planning, disaster prevention, flood forecasting and warning as well as emergency information sharing among relevant agencies, (ii) development and maintenance of EWSs for GLOF/rainstorm in the pilot basins of the Mangdechhu and the Chamkharchhu, and (iii) enhancement of emergency response capacity against GLOF/rainstorm flood at central and local levels in the pilot basins, thereby realizing nationwide disaster resilient society against natural disasters such as GLOF and rainstorm flood for Climate Change Adaptation in Bhutan.</p> <ol style="list-style-type: none"> Overall Goal: Nationwide disaster resilient society against natural disasters such as GLOF and rainstorm flood for Climate Change Adaptation is realized in Bhutan. Project Purpose: Capacity of DHMS and relevant stakeholders on emergency response against GLOF/rainstorm flood is enhanced. 				
Activities of the Project	<ol style="list-style-type: none"> Project site: Thimphu and the Mangdechhu and the Chamkharchhu basins (as the pilot basins). Main activities: Discussions on Mainstreaming Disaster Risk Reduction, preparation of GLOF/rainstorm flood risk zonation maps of the pilot basins, improvement of weather/flood forecasting system of DHMS, development of standard operation procedure (SOP) on emergency information sharing at central level, development and maintenance of the EWSs for GLOF/rainstorm in the pilot basins, planning and implementation of EWS operation drills in the pilot basins, planning and implementation of warning and evacuation drills at the high-risk target communities/schools through Community Based Disaster Risk Management (CBDRM) and developing awareness-raising plans about the EWS at the low-risk target communities in the pilot basins¹, development of the SOP for GLOF/rainstorm flood in the pilot basins. Inputs (to carry out above activities) <table border="0" style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> Japanese Side 1) Experts: 9 persons 2) Trainees received: 29 persons 3) Equipment: Equipment for Global Telecommunication System (GTS)/Message Switching System (MSS) and HimawariCast Receiving System in DHMS, and equipment for EWS (Automatic Weather Station (AWS), Automatic Water Level Stations (AWLSs), etc.), and evacuation drills in the pilot basins, etc. 4) Local cost </td> <td style="width: 50%; vertical-align: top;"> Bhutanese Side 1) Staff allocated: 46 persons (40 from DHMS, 1 each from Department of Disaster Management (DDM), Department of Geology and Mines, and National Land Commission Secretariat, and 3 from Department of Engineering Service) 2) Building and facilities: Office space for experts at DHMS, etc. 3) Local cost </td> </tr> </table> 			Japanese Side 1) Experts: 9 persons 2) Trainees received: 29 persons 3) Equipment: Equipment for Global Telecommunication System (GTS)/Message Switching System (MSS) and HimawariCast Receiving System in DHMS, and equipment for EWS (Automatic Weather Station (AWS), Automatic Water Level Stations (AWLSs), etc.), and evacuation drills in the pilot basins, etc. 4) Local cost	Bhutanese Side 1) Staff allocated: 46 persons (40 from DHMS, 1 each from Department of Disaster Management (DDM), Department of Geology and Mines, and National Land Commission Secretariat, and 3 from Department of Engineering Service) 2) Building and facilities: Office space for experts at DHMS, etc. 3) Local cost
Japanese Side 1) Experts: 9 persons 2) Trainees received: 29 persons 3) Equipment: Equipment for Global Telecommunication System (GTS)/Message Switching System (MSS) and HimawariCast Receiving System in DHMS, and equipment for EWS (Automatic Weather Station (AWS), Automatic Water Level Stations (AWLSs), etc.), and evacuation drills in the pilot basins, etc. 4) Local cost	Bhutanese Side 1) Staff allocated: 46 persons (40 from DHMS, 1 each from Department of Disaster Management (DDM), Department of Geology and Mines, and National Land Commission Secretariat, and 3 from Department of Engineering Service) 2) Building and facilities: Office space for experts at DHMS, etc. 3) Local cost				
Project Period	(ex-ante) October 2013-September 2016 (actual) October 2013-September 2016	Project Cost	(ex-ante) 401 million yen, (actual) 550 million yen		
Implementing Agency	Implementing agency: Department of Hydro-met Service (DHMS) /Ministry of Economic Affairs. * Sub-implementing agency: Department of Disaster Management (DDM), Department of Geology and Mines (DGM), Department of Engineering Service, and National Land Commission Secretariat. *After the project completion, DHMS was reorganized into an autonomous agency called National Center for Hydrology and Meteorology (NCHM).				
Cooperation Agency in Japan	Earth System Science Co. Ltd.				

II. Result of the Evaluation

< Special Perspectives Considered in the Ex-Post Evaluation >

- The target area for the Project Purpose Indicator 1 was not specified in the logical framework, but it was interpreted to be the pilot basins based on the description of "Project Site" of the logical framework.
- The Project Purpose Indicator 2 ("Early warning and evacuation drills in the pilot basins are regularly conducted by use of developed EWS (at least

¹ The high-risk target communities/schools consisted of 1 community in the Mangdechhu and 2 communities and 2 schools in the Chamkharchhu basin. The low-risk target communities consisted of 2 communities in the Chamkharchhu basin.

once in a year”) was not feasible because the drills in the pilot basins were planned only once in the final year of the project according to the original/latest schedule. The terminal evaluation of the project pointed out that it was difficult/too early to verify regular implementation of the drills and, took into account the prospects for the regular implementation based on the changes before and after the project in making evaluation judgement. This ex-post evaluation verified this indicator with the same perspective as that of the terminal evaluation.

- As the Overall Goal was defined as the goal to be achieved 3-5 years after the project completion in the project completion report (PCR), the target year was set to be September 2021, 5 years after the project completion.
- The description of the Overall Goal Indicator 1 (“GLOF/rainstorm flood forecasting and early warning is properly disseminated based on accumulation of hydro-met data to relevant agencies at central and local levels as well as outside of pilot river basins”) was considered to have meant that “...in the pilot river basins as well as outside of pilot river basins” In addition, definition of the phrase “properly disseminated” was not clear in the existing documents related to the project. In this ex-post evaluation, it was defined to be “reliable information is shared following the protocols laid down in the developed SOP” according to the understanding of NCHM at the time of the project implementation, which was confirmed through the field survey.

1 Relevance

<Consistency with the Development Policy of Bhutan at the Time of Ex-Ante Evaluation>

At the time of ex-ante evaluation, the project was consistent with the development policy of the Bhutanese government, which included GLOF as a priority issue in the 10th Five Year Plan (FYP) (2008-2013). In addition, measures against GLOF were regarded as a top priority in the National Adaptation Program of Actions (NAPA) (2006) and the National Disaster Risk Management Framework (2006).

<Consistency with the Development Needs of Bhutan at the Time of Ex-Ante Evaluation>

At the time of ex-ante evaluation, the project was consistent with the needs of Bhutan for capacity development for GLOF and rainstorm flood forecasting and early warning as described in the “Background”.

<Consistency with Japan’s ODA Policy at the Time of Ex-Ante Evaluation>

At the time of ex-ante evaluation, the project was consistent with the Japanese ODA policy for South Asia Region, which included assistance to address environmental and climate change issues caused by population growth and economic development under the basic policy².

<Evaluation Result>

In light of the above, the relevance of the project is high.

2 Effectiveness/Impact

<Status of Achievement of the Project Purpose at the Time of Project Completion>

The Project Purpose was achieved at the time of project completion judging from the achievement status of 2 indicators (“achieved” and “partially achieved”). The GTS/MSS and HimawariCast Receiving System were installed at the National Weather Forecasting and Warning Center (NFWFC)/DHCM (currently NCHM) and the EWS for GLOF/rainstorm flood was installed in the 2 pilot basins³ in March 2016. After the training on the installed systems, DHMS (currently NCHM) started operation of the EWS in the 2 pilot basins in May 2016. From then, the GLOF/rainstorm flood forecasting and early warning (EW) was in place for 24 hours a day, 7 days a week (24/7) in accordance with the SOP developed under the project⁴ (Indicator 1). Using the EWS developed under the project, the evacuation drills were conducted at the target communities/schools for CBDRM in the 2 pilot basins once in March 2016, the final year of the project, as scheduled (target: regular implementation of the drills in the 2 pilot basins). Although the progress was observed, it was difficult/too early to verify the regular implementation of the drills. Meanwhile, the target communities were committed to the CBDRM activities including the preparation for the drills. Additionally, in the Chamkharchhu basin, DDM was planning to incorporate the evacuation plans including regular drills into the District Disaster Management Plan (DDMP) for Bumthang District, where the basin was located. The commitment shown by the above-stated local stakeholders suggested the drills in the 2 pilot basins could be conducted regularly based on the experiences of the project (Indicator 2).

<Continuation Status of Project Effects at the Time of Ex-post Evaluation>

The project effects were continued at the time of ex-post evaluation. As discussed by the relevant agencies in the project, the Inter-Ministerial Task Force was established in 2018 and functioning as an institute for mainstreaming disaster risk assessment information into development plans. Utilizing the EWS developed under the project, the GLOF/rainstorm flood forecasting and EW was continuously in place for 24/7 in the 2 pilot basins in accordance with the developed SOP⁵. In the Mangdechhu basin, the EW and evacuation drill for GLOF/rainstorm flood at the target community was conducted only once in 2018. NCHM was not able to coordinate the EW and evacuation drills in the other years mainly because the district administration for Trongsa, where the basin was located, prioritized the evacuation drills for the most recent hazards/the hazards with the most recently perceived risks such as earthquake and fire and the new District Disaster Management Officer (DDMO)⁶ assigned in 2020 was not sufficiently aware of the importance of the drills for the GLOF/rainstorm flood. It is noted that the Disaster Management Contingency Plan (DMCP), formerly known as the DDMP, for Trongsa District developed after the project completion (also see <Other Impacts>) covered the GLOF/rainstorm flood along with other disasters.

² ODA data collection (2013).

³ The installed EWS composed of automatic hydro-meteorological observation stations (AWS/ALWS), a control room which integrated data from the observation stations, and siren towers to warn the floods to the target communities/schools.

⁴ In the Chamkharchhu basin, all the EWS warning sirens were activated on July 26, 2016, upon the water level reaching the Alarm Level because of the extraordinary continuous monsoon rain. After that, the EWS was operated appropriately using the O& M manual developed under the project and the emergency information was communicated to the local government and local DDM according to the SOP. That appropriate procedure resulted in the safety evacuation of the target community people.

⁵ One of the 2 AWLSs installed in the Mangdechhu basin was not functional due to damage caused by a sudden flash flood in October 2020. The damaged AWLS had been used for flash flood forecasting and EW. As the interim measure until replacement of the damaged AWLS, 24/7 flood observation was conducted visually by NCHM and information was transmitted to the control room during the increase in water level based on the developed SOP.

⁶ A DDMO was a focal person in disaster management at district level. The DDMO was recruited by DDM and deputed to district administration. The DDMO also reported to DDM. During the project implementation, the DDMOs in charge of the pilot basins (then) participated in planning and implementation of the EW and evacuation drills.

Instead of the regular drills, public awareness campaign on the GLOF/rainstorm flood disasters was regularly conducted, utilizing the experiences of the project⁷. According to the DDMO, the public awareness for the GLOF/rainstorm flood raised through the campaign may have been one of the important factors that helped the target community people to evacuate safely during the flash flood in October 2020. The past experiences of the EW and evacuation drills also facilitated the safe evacuation of the target community people. Recognizing the importance of the EW and evacuation drills, the DDMO was planning to propose to the district administration an EW and evacuation drill or at least a public awareness activity before the monsoon season in the ongoing fiscal year (July 2021-June 2022). On the other hand, in the Chamkharchhu basin, regular evacuation drills were incorporated into the DMCP as planned at the time of project completion. According to the DMCP, the EW and evacuation drills at the 2 target schools were conducted once a year, but those at the 2 target communities could not be conducted in 2018 because of change of the DDMO for Bumthang District and from 2020 due to restriction of gathering imposed by the COVID-19 pandemic. Based on the fact that the regular drills were incorporated in the DMCP and the trend prior to the COVID-19 pandemic, it can be reasonably assumed that the regular drills at the target communities would have continued without the COVID-19 pandemic. It should be also noted that, when the drills could not be conducted, the DDMO along with volunteers organized awareness campaigns against GLOF/rainstorm flood disasters as an alternative measure, using the experiences and the materials and human resources developed from the project.

<Status of Achievement for Overall Goal at the Time of Ex-post Evaluation>

The Overall Goal was achieved at the time of ex-post evaluation. GLOF/rainstorm flood forecasting and EW was properly disseminated based on accumulation of hydro-met data to the relevant agencies at central and local levels in the 2 pilot basins well as outside of pilot river basins. In the 2 pilot basins, GLOF/rainstorm flood forecasting and EW was shared to the relevant agencies, following the protocols laid out in the developed SOP. Outside the 2 pilot basins, NCHM in collaboration with DDM established an interim community flood EWS for a temporary resettled community at a newly constructed shelter in the Ammochhu basin⁸ and developed the SOP for the flood EWS in 2020, utilizing the capacity and experiences acquired in the project⁹. Rainstorm flood forecasting and EW was shared to the relevant agencies, following the protocols laid out in the SOP for the flood EWS. The information shared to the stakeholders in the above-mentioned 3 basins was reliable because NCHM staff gained practical experiences which helped to make judgement when to issue advisory and warning to them through continuous observation at 24/7 operation of the NWFWC and the EWSs as well as availability of more accumulated hydro-met time-series data from the fields (Indicator 1). For the above-mentioned resettled community in the Ammochhu basin, NCHM and DDM had a plan to conduct an annual EW and evacuation drill before the monsoon season. The drill was conducted in 2020 based on the experiences gained from the project together with awareness campaign against flood disasters. NCHM and DDM planned the drill in 2021 but could not implement it due to restriction of gathering imposed by the COVID-19 pandemic. It can be reasonably assumed that the drill in 2021 would have conducted without the COVID-19 pandemic (target: evacuation drills at least in one community outside the pilot basins) (Indicator 2).

<Other Impacts at the time of Ex-post Evaluation>

Some other positive impacts were observed. For example, NCHM conducted the water line survey of the Thimpuchhu, the Parochhu and the Hachhu for flood hazard mapping, utilizing the acquired skills and knowledge. In the Mangdechhu basin, Mangdechhu Hydro Power Authority (MHPA) utilized the EWS established under the project in conducting its mandatory evacuation drills¹⁰. There were synergetic effects between this project and NAPA II project (2014-2018) financed by Least Developed Countries Fund (LDCF) through United Nations Development Programme. A staff member from NCHM and the DDMO for Trongsa District (then), who had participated in the project as the Project Manager and the key focal person in disaster management at district level, were involved in the training program conducted by DDM under NAPA II project, which included development of the DMCP for Trongsa District and the SOP for the CBDRM activities. Meanwhile, negative impacts were not observed.

<Evaluation Result>

Therefore, the effectiveness/impact of the project is high.

Achievement of Project Purpose and Overall Goal

Aim	Indicators	Results	Source
(Project Purpose)	Indicator 1: GLOF/rainstorm flood forecasting and early warning is in place in accordance with developed SOP.	Status of the Achievement (Status of the Continuation): achieved (continued) (Project Completion) -From 2016, GLOF/rainstorm flood forecasting and early warning was in place in the 2 pilot basins in accordance with the SOP for emergency information sharing, utilizing the EWSs developed under the project. (Ex-post Evaluation) -Utilizing the developed EWSs, GLOF/rainstorm flood forecasting and early warning was continuously operational 24/7 in the 2 pilot basins in accordance with the developed SOP.	Project Completion Report (PCR), questionnaire and interview survey to NCHM
Capacity of DHMS and relevant stakeholders on emergency response against GLOF/rainstorm	Indicator 2: Early warning and evacuation drills in the	Status of the Achievement (Status of the Continuation): partially achieved (partially continued)	Terminal Evaluation

⁷ The awareness campaigns would provide all the relevant information such as the evacuation sites, paths and the other Dos and Don'ts during a GloF or rainstorm flooding, which was derived from the experience of the project.

⁸ The interim EWS was established based on the urgency during the monsoon by using the existing available network of hydrological and meteorological observing stations upstream on the Ammochhu as well as GTS/MSS and HimawariCast Receiving System provided under the project. The flood warning levels were marked at 2 bridges with levels of threshold warning (Alert and Alarm). A temporary 24/7 Control Room was established to monitor and communicate with upstream field stations. The system was operated during the monsoon season from May to October. Warnings were disseminated to the community through the local government and other focal points identified.

⁹ In addition, utilizing the capacity and the experiences of the project, 2 more rainstorm flood EWSs were being established in the basins of the Thimpuchhu and the Parochhu under the succeeding project of JICA ("Project for Capacity Enhancement of Meteorological Observation, Forecasting and Flood Warning, for Disaster Preparedness and Response in Thimphu and Paro River Basins" (2020-2023)), which were expected to be operational in 2023.

¹⁰ During the project implementation, the control room of the EWS was installed at the MHPA dam colony and MHPA participated in the workshop for the SOP for GLOF/flood in the Mangdechhu basin.

<p>flood is enhanced.</p>	<p>pilot basins are regularly conducted by use of developed EWS (at least once in a year).</p> <p>*Please see the 2nd point of <Special Perspectives Considered in the Ex-post Evaluation>.</p>	<p>(Project Completion)</p> <p>-Using the EWSs developed under the project, EW and evacuation drills were conducted once at the target communities/schools in the 2 pilot basins in March 2016, the final year of the project as scheduled. Although the progress was made, it was difficult/too early to verify the regular implementation of the drills.</p> <p>-The target communities/schools in the 2 pilot basins were committed to the CBDRM activities including preparation for the drills. Additionally, in the Chamkharchuu basin, DDM was planning to incorporate the evacuation plan including regular drills into the DDMP. The commitment shown by the above-stated local stakeholders suggested the drills could be conducted regularly in the 2 pilot basins based on the experiences of the project.</p> <p>(Ex-post evaluation)</p> <table border="1" data-bbox="512 398 1396 633"> <thead> <tr> <th rowspan="2">Pilot basins</th> <th rowspan="2">Target community/school</th> <th colspan="5">No. of EW and evacuation drills conducted</th> </tr> <tr> <th>2017</th> <th>2018</th> <th>2019</th> <th>2020</th> <th>2021</th> </tr> </thead> <tbody> <tr> <td>Mangdechhu</td> <td>Bjizam Village</td> <td>0*¹</td> <td>1</td> <td>0*¹</td> <td>0*^{1,2}</td> <td>0*¹</td> </tr> <tr> <td rowspan="3">Chamkharchhu</td> <td>Wangdicholing Village</td> <td>1</td> <td>0*¹</td> <td>1</td> <td>0*^{1,2}</td> <td>0*¹</td> </tr> <tr> <td>Chamkhar Town</td> <td>1</td> <td>0*¹</td> <td>1</td> <td>0*^{1,2}</td> <td>0*^{1,2}</td> </tr> <tr> <td>Chokhortoe Primary School</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td></td> <td>Gangrithang Primary School</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table> <p>*1: GLOF/rainstorm flood disaster awareness campaign was implemented as an alternative measure. *2: The drills were planned before the monsoon season but could not be implemented due to restriction of gathering posed by the COVID-19 pandemic.</p>	Pilot basins	Target community/school	No. of EW and evacuation drills conducted					2017	2018	2019	2020	2021	Mangdechhu	Bjizam Village	0* ¹	1	0* ¹	0* ^{1,2}	0* ¹	Chamkharchhu	Wangdicholing Village	1	0* ¹	1	0* ^{1,2}	0* ¹	Chamkhar Town	1	0* ¹	1	0* ^{1,2}	0* ^{1,2}	Chokhortoe Primary School	1	1	1	1	1		Gangrithang Primary School	1	1	1	1	1	<p>Report, PCR, questionnaire and interview survey to DDM</p>
Pilot basins	Target community/school	No. of EW and evacuation drills conducted																																														
		2017	2018	2019	2020	2021																																										
Mangdechhu	Bjizam Village	0* ¹	1	0* ¹	0* ^{1,2}	0* ¹																																										
Chamkharchhu	Wangdicholing Village	1	0* ¹	1	0* ^{1,2}	0* ¹																																										
	Chamkhar Town	1	0* ¹	1	0* ^{1,2}	0* ^{1,2}																																										
	Chokhortoe Primary School	1	1	1	1	1																																										
	Gangrithang Primary School	1	1	1	1	1																																										
<p>(Overall Goal)</p> <p>Nationwide disaster resilient society against natural disasters such as GLOF and rainstorm flood for Climate Change Adaptation is realized in Bhutan.</p>	<p>Indicator 1: GLOF/rainstorm flood forecasting and early warning is properly disseminated based on accumulation of hydro-met data to relevant agencies at central and local levels (in the pilot river basins) * as well as outside of pilot river basins.</p> <p>*Please see the 4th point in <Special Perspective Considered in the Ex-post Evaluation>.</p> <p>Indicator 2: Evacuation drills are conducted at least in one community outside of pilot river basin with EWS.</p>	<p>(Ex-post Evaluation) achieved</p> <p>-In the 2 pilot basins, GLOF/rainstorm flood forecasting and EW was shared to the relevant agencies at central and local levels based on the accumulated hydro-met data, following the protocols laid out in the developed SOP.</p> <p>-In 2020, NCHM in collaboration with DDM established an interim community flood EWS for a temporary resettled community in the Ammochhu basin and developed the SOP for the flood EWS, utilizing the capacity and the experience gained from the project. Rainstorm flood forecasting and EW was shared to the relevant agencies at central and local levels during the monsoon season based on the accumulated hydro-met data, following the protocols laid out in the developed SOP.</p> <p>-The information shared to the stakeholders in these 3 basins was reliable because NCHM staff gained practical experiences which helped to make judgement when to issue advisory and warning through continuous observation and 24/7 operation of the NWFCs and the EWSs as well as availability of more accumulated hydro-met time-series data from the fields.</p> <p>(Ex-post Evaluation) achieved</p> <table border="1" data-bbox="512 1220 1396 1413"> <thead> <tr> <th rowspan="2">Basin outside the pilot basins.</th> <th rowspan="2">Year of establishment of EWS</th> <th rowspan="2">Community</th> <th colspan="2">(Ref) No. of drills conducted</th> </tr> <tr> <th>2020</th> <th>2021</th> </tr> </thead> <tbody> <tr> <td>Ammochhu</td> <td>2020</td> <td>Temporary resettled community in Phuentsholing City</td> <td>1</td> <td>0*</td> </tr> </tbody> </table> <p>*NCHM and DDM planned to conduct a drill before the monsoon in 2021 but could not carry it out due to restriction of gathering posed by the COVID-19 pandemic.</p>	Basin outside the pilot basins.	Year of establishment of EWS	Community	(Ref) No. of drills conducted		2020	2021	Ammochhu	2020	Temporary resettled community in Phuentsholing City	1	0*	<p>Questionnaire and interview survey to NCHM</p> <p>Questionnaire and interview survey to NCHM and DDM</p>																																	
Basin outside the pilot basins.	Year of establishment of EWS	Community				(Ref) No. of drills conducted																																										
			2020	2021																																												
Ammochhu	2020	Temporary resettled community in Phuentsholing City	1	0*																																												

3 Efficiency

Although the project cost exceeded the plan (ratio against the plan: 137%), the project period was within the plan (ratio against the plan: 100%). The outputs of the project were produced as planned. Therefore, the efficiency of the project is fair.

4 Sustainability

<Policy Aspect>

NAPA (2016) and the National Disaster Risk Management Framework (2006) mentioned in “Relevance” are still effective. In addition, promotion of emergency response against GLOF/rainstorm flood was supported by the 12th FYP, which included “carbon neutrality, climate and disaster resilient” in one of the National Key Result Areas.

<Institutional/Organizational Aspect>

The Inter-Ministerial Task Force established in 2018 was functioning as an institute for mainstreaming disaster risk assessment information into development plans. Reorganization of DHMS into NCHM strengthened its roles in GLOF/rainstorm flood forecasting and EW because NCHM was designated as the Hydro-met Hazard EW Service Provider in the country in 2019 vide the Government Order issued by the Prime Minister. Organizational structure of DDM for emergency response preparedness for natural disasters remained unchanged and functioning. The number of staff of NCHM was increased compared to erstwhile DHMS. As of August 2021, the number of staff of NCHM was 192, which was 87% of the quota. NCHM stated that number of staff was sufficient compared with erstwhile DHMS for delivery of basic services. DDM also considered that the number of staff was sufficient because it also expanded its human resources both in the department and the districts.

<Technical Aspect>

NCHM sustained/updated the acquired skills and knowledge through applying them in their daily operations as well as conducting field works, workshops and hands-on training. In addition, it was made mandatory for any staff who would take a long-term study leave to conduct

necessary training and hands on exercise to the successor. DDM also sustained the acquired skills and knowledge through conducting evacuation drills, disaster awareness campaigns etc. in collaboration with NCHM. The manuals and materials developed under the project were continuously used by them. The equipment provided under the project was maintained in good condition and utilized except for one of the AWLS installed in the Mangdechhu basin, which was damaged by the sudden flash flood in October 2020. The damaged AWLS was not replaced yet mainly because NCHM was conducting the full-season-cycle site survey to identify the new location for the AWLS¹¹. NCHM was already in contact with the Japanese manufacturer and discussing with the government and MHPA for replacement of the damaged AWLS. Once the exact location for the new site for the AWLS was identified, the budget would be deliberated further and full-scale discussions on the replacement would start. It is noted that, the effect of the breakdown of the AWLS was minimized because the EWS in the Mangdechhu basin continued functioning by the visual observation as the interim measure until the replacement¹².

<Financial Aspect>

The budget for NCHM had been increasing since 2016 to support the activities relating to GLOF/rainstorm flood forecasting and EW. NCHM secured the necessary budget to sustain the project effects, including the budget for operation and management of the EWS established in the 2 pilot basins and the Ammochhu basin. DDM secured the budget for emergency response preparedness for natural disasters in general, including GLOF and rainstorm flood, for all 20 districts from the national budget and international organizations such as LDCF/UNDP, World Food Programme, and Save the Children.

<Evaluation Result>

In light of the above, no problem has been observed in terms of the policy, institutional/organizational, technical, and financial aspects. Therefore, the sustainability of the project effects is high.

5 Summary of the Evaluation

The project achieved the Project Purpose of enhancing the capacity of DHMS (presently NCHM) and relevant stakeholders on emergency response against GLOF/rainstorm flood. The effects of the project continued and the Overall Goal of realization of nationwide disaster resilient society against natural disasters such as GLOF and rainstorm flood for Climate Change Adaptation was achieved. As for the sustainability, no problems were observed in terms of the policy, institutional/organizational, technical and financial aspects. Regarding the efficiency, the project cost exceeded the plan. Considering all of the above points, this project is evaluated to be highly satisfactory

III. Recommendations & Lessons Learned

Recommendations for Implementing Agency:

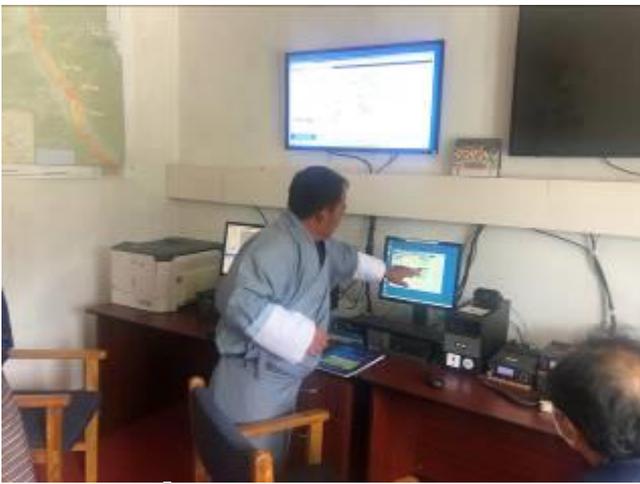
-After the relaxation of the restrictions that are currently imposed due to COVID-19 pandemic, NCHM and DDM are recommended to conduct regular EW and evacuation drills at the high-risk community (i.e., Bijezam Village) in the Mangdechhu basin in collaboration with the district administration of Trongsa to enhance the preparedness of the community against GLOF/rainstorm flood disasters. For this, DDM and NCHM are recommended to assist the new DDMO to raise the awareness of the district disaster management committee on the risks of the GLOF/rainstorm flood and the importance of the EW and evacuation drill, an effective way would be to revisit the example of the recent flash flood at Bijezam on 1st October 2020. Such awareness can help the district disaster management committee to prioritize the evacuation drills for the GLOF/rainstorm flood disasters along with other disasters. In the future, if there is a change of DDMO, NCHM and DDM are recommended to discuss with a new DDMO on the risks of GLOF/rainstorm flood and the needs of the EW and evacuation drills. This is to make sure that the EW and evacuation drills or at least public awareness campaign be carried on. Or DDM is recommended to modify the /DMCP for Trongsa to include regular EW and evacuation drills and awareness campaign so that they could be carried on even if there is a change in DDMO in the future.

Lessons Learned for JICA:

- In the projects pertaining to disaster preparedness in Bhutan, it is important to ensure that the preparedness activities like evacuation drills and awareness programs should be made part of the project work plan for any target districts as in the case of this project. Before the project completion, the importance of evacuation drills and awareness campaigns must be made part of the DMCPs for the target districts (or their equivalents for the target disasters) as in the case of Bumthang District, a target district of this project. . For example, this lesson should be applied to the ongoing technical cooperation project “Capacity Enhancement of Meteorological Observation, Forecasting and Flood Warning, for Disaster Preparedness and Response in Thimpu and Paro River Basins” (2020-2023). For this project, the JICA experts and the central implementing agencies like the DDM and NCHM will need to include the aspects of evacuation drills and awareness campaigns like the hazard map familiarization, evacuation centers identification, community roles in evacuation in the flood SOPs to be formulated during the project implementation to ensure that these activities are carried on even after the project.

¹¹ The flash flood did not only damage the AWLS but changed the river flow and profile, thereby requiring the site survey to see the feasibility of the new location for AWLS along with costs for equipment replacement.

¹² Also see footnote 5.



24/7 Manned Control Room at Kurjey
in the Chamkharchhu Basin.



24/7 Manned Control Room at MHPA Dam Colony
in the Manngdechhu Basin.