CARIBBEAN DISASTER
EMERGENCY MANAGEMENT AGENCY

CARIBBEAN DISASTER MANAGEMENT PROJECT PHASE 2

FINAL REPORT

JUNE 2012

JAPAN INTERNATIONAL COOPERATION AGENCY

IDEA Consultants, Inc.
EARTH SYSTEM SCIENCE CO., LTD.

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Pilot States of the Project

Photographs of the Project Activity

JCC Meeting (Barbados)

Country Mission (Guyana)

Meeting with NT (Dominica)

Training in Japan

CBDRM Activities (Belize)

Inspection of Hydro. Equipment (Guyana)

Consultation Meeting (Grenada)

Preparation of FHM (Dominica)

GIS Training in CIMH (Barbados)

Flood Mark Survey (Guyana)

New Rainfall Station (St. Lucia)

Evacuation Drill (St. Lucia)

New Water-level Station (Grenada)

New Water-level Station (St. Lucia)

CBDRM Activities (Grenada)

Evacuation Drill (Dominica)

Caribbean Disaster Management Project Phase 2
Final Report

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ABBREVIATION

CADM2:	Caribbean Disaster Management Project Phase 2
CBDRM:	Community-based Disaster Risk Management
CDC:	Civil Defense Commission
CDEMA:	Caribbean Disaster Emergency Management Agency
CDM	Comprehensive Disaster Management
CIMH:	Caribbean Institute of Meteorology and Hydraulics
DEM:	Digital Elevation Model
DIG:	Disaster Imagination Game
DWG:	Drawing
GB:	Giga byte
GHz:	Giga Hertz
GIS:	Geographical Information System
HDD:	Hard Disc Drive
HEC-HMS:	Hydrologic Engineering Center- Hydrologic Modeling System
HEC-RAS:	Hydrologic Engineering Center-River Analysis System
HYDATA:	Hydrological Database and Analysis Software
IC/R:	Inception Report
IT/R:	Interim Report
JICA:	Japan International Cooperation Agency
MAFF:	Ministry of Agriculture, Fishery and Forest
NaDMA:	National Disaster Management Agency
NBM:	National Bench Mark
NEMO:	National Emergency Management Organization
NT:	National Team
ODM:	Office of Disaster Management
PDM:	Project Design Matrix
RAM:	Random Access Memory
RT:	Regional Team
SRTM:	Shuttle Radar Topography Mission
TBM:	Temporary Bench Mark
TIF:	Tagged Image File
UG:	University of Guyana
UWI:	University of the West Indies
WIS:	Water Information System
WMS:	Watershed Modeling System
PDM:	Project Design Matrix

1. INTRODUCTION

1.1 Background of the Project

The Caribbean Disaster Management (CADM) Project was implemented under the Caribbean Community (CARICOM)/Japan Technical Cooperation Agreement through the Caribbean Disaster Emergency Management Agency (CDEMA) with the support of the Japan International Cooperation Agency (JICA). The Project was initiated in August 2002 and ended in March 2006.

Although the CADM project has sought to mitigate damages in the CDEMA participating states and made a significant contribution to the implementation of the Comprehensive Disaster Management (CDM) Strategy developed by CDEMA, the Caribbean countries are still put in danger by repeated natural disasters such as hurricanes and their associated strong winds and storm surges, floods, and landslides, as well as volcanic eruptions and earthquakes. In addition to these traditional hazards, recent rises in the sea level brought about by global climate change have occurred. Flooding which is the most commonly occurring hazard in the CDEMA participating states has been a silent development killer, necessitating urgent attention.

Concerning the above situation, the Government of Barbados requested to the Government of Japan the technical cooperation on the Caribbean Disaster Management (CADM) Project Phase 2 (hereinafter referred to as "the Project") in 2006, in order to conduct capacity development for the selected engineers in CDEMA, the Caribbean Institute of Meteorology and Hydrology (CIMH), the University of the West Indies (UWI), the University of Guyana (UG) and other relevant organizations in Belize, Dominica, Grenada, Guyana and St. Lucia where the pilot project will be implemented.

Responding to that, the Government of Japan approved the implementation of the CADM Project Phase 2 in 2007 and JICA dispatched a preparatory study team to design the project. During the preparatory study, the Record of Discussion (R/D) of the cooperation was signed and exchanged on August 11, 2008 between the Ministry of Foreign Affairs of Barbados, CDEMA and JICA. After that, R/Ds were singed and exchanged between each government of Belize, Commonwealth of Dominica (Dominica), Grenada, Republic of Guyana (Guyana) and Saint Lucia and JICA.

CADM Project Phase 2 was commenced in January 2009 and terminated in June 2012. The first year activities in the Caribbean region were carried out from February 2009 to March 2010 and the second year activities were carries out from June 2010 to March 2011. The third activities were carried out from June 2011 to June 2012. This report summarizes the activities and achievement of the respective periods.

1.2 Outline of the Project

The CADM Project Phase 2 was designed as follows:

(1) Super Goal
Disaster damage in the CDEMA Participating States is mitigated.

(2) Overall Goal
Disaster damages in the CDEMA Participating States are mitigated through enhancement of community resilience to the flood hazard (Similar project is implemented in flood vulnerable areas other than pilot sites of the CDEMA Participating States).

(3) Project Purpose
Capacity of CDEMA and five pilot states for managing the flood risk is increased (RT has the

capacity to establish Flood Early Warning System (FEWS) in a flood vulnerable area with use of Flood Hazard Map (FHM) and Community Disaster Management Planning (CDMP) prepared by RT with the cooperation of NT).

(4) Outputs

1) FHMs are prepared, CDMPs are prepared and implemented, and FEWSs are established and implemented at the pilot sites.
2) Capability of RT to develop FHM and to establish FEWS is upgraded.
3) Hydrological database is established and functioning at CIMH (Efficient and effective use of the hydrological database becomes possible for FH mapping and FEWS establishing).

1.3 Project Area

Project area covers Barbados as the state where CDEMA and Caribbean Institute of Meteorology and Hydrology (CIMH) are located, Belize, Dominica, Grenada, Guyana and Saint Lucia as pilot states of CDEMA participating states. The locations of these states are shown in Fig. 1-1. Disaster management organization of the pilot states are shown in Table 1.1

Table 1-1 Disaster Management Organization of Pilot States

	Guyana	Grenada	Belize	Saint Lucia	Dominica
Disaster Management Organization	Civil Defense Commission (CDC)	National Disaster Management Agency (NADMA)	National Emergency Management Organization (NEMO)	National Emergency Management Organization (NEMO)	Office of Disaster Management (ODM)
Number of Staff	10	12	10	7	4
Area (km^2)	214,970	344	22,966	616	754
Population (2006)	750,000	110,000	290,000	170,000	70,000
Geography	Continent	Volcanic Island	Continent	Volcanic Island	Volcanic Island
Flood Type	River Flood	Flash Flood	River Flood	Flash Flood	Flash Flood

Fig. 1-1 Location of Project Area

2. SUMMARY OF PROJECT MANAGEMENT

2.1 Project Design Matrix

Revision of Project Design Matrix (PDM)
At the beginning of the project, "Overall Goal", "Project Purpose" and "Output", those were agreed in the RD, were revised to a concrete expression and University of Guyana (UG) was added as " Inputs (CDEMA Side)". In addition, "Activities" on sustainability plan and action plan for the "Outputs (Item 2)" were also additional considered in the JCC meeting during the project activity period.

The revision of Project Design Matrix was officially made through the discussion with Caribbean side during the Terminal Evaluation of the Project by JICA.

Revised items of Project Design Matrix are as follows;

1) Overall Goal
2) Project Purpose
3) Outputs
4) Activities (Output 2)
5) Inputs (CDEMA Side)

Original and revised PDM are as shown in Table 2-1.

Table 2-1 Project Design Matrix (1/2): Original PDM

Project Name : Caribbean Disaster Management Project Phase 2
Implementing Agency : The Caribbean Disaster Emergency Management Agency (CDEMA)
Duration : From July 2008 to June 2011
Prepared on : 28 November 2007

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
(Super Goal) Disaster damage in CDERA member states is mitigated.	・Annual number of affected persons in CDERA member states will become under a targeted number. ・Annual amount of property business losses in CDERA member states will become under a targeted amount.	Damage information in CDERA member states	
(Overall Goal) Disaster damages in CDERA Participating States are mitigated through Enhancement of Community Resilience to the flood hazard	・Among the disaster-prone areas in CDERA member states, for areas of more than 10% hazard maps prepared. ・Among the disaster-prone areas in CDERA member states, for more than 10% CDMP area prepared.	・CDERA's Annual Reports ・Interview to CDERA and member states	Comprehensive Disaster Management (CDM) Plan is implemented.
(Project Purpose) Capacity of CDERA and five pilot states for managing the flood hazard is increased.	・At more than half of the pilot states, RT-made hazard maps and CDMPs are prepared and flood early warning systems are prepared. ・Sustainability Plan of RT and NT for maintaining the technical capacity and organizational system	Project reports Sustainability Plan	Disaster Policies of the Caribbean Community are not largely changed CDERA and disaster agencies of member states are properly budgeted and staffed. No rapid change in natural environment will occur.
(Outputs) 1, Early Warning Systems for the flood hazard established and implemented at the pilot sites.	1-1 Flood hazard maps are prepared at the pilot sites. 1-2 CDMPs are prepared at the pilot sites. 1-3 Flood early warning system are established in the whole of the pilot sites.	1-1 Project Reports 1-2 Project Reports 1-3 Project Reports	Counterparts who received technology transfer continue to stay in CDERA, RT and NT.

2. Capability of the Regional Team to develop flood hazard maps and to establish flood early warning systems upgraded.	2-1 Flood Hazard Mapping Manual is revised more than once a year. 2-2 CDM Planning Manual is revised. 2-3 Manual for establishing early warning system is prepared and distributed to related agencies. 2-4 Workshop for developing flood early warning system using hazard maps and CDMPs are held more than twice a year. 2-5 Capacity of RT engineers for flood hazard mapping, CDMP preparation and establishment of flood early warning system is improved.	2-1 Revised manual 2-2 Revised manual 2-3 Project Reports 2-4 Project Reports 2-5 Interview to RT counterparts	
3. Hydrological database is established and functioning at the CIMH.	3-1 Hydrological database is established in CIMH. 3-2 Web-based hydrological data collection, management and dissemination program is developed. 3-3 Hydrological data is supplied from CDERA member states through the program more than 2 times a year. 3-4 The hydrological data base through the program is accessed by CDERA member states more than 2 times a year.	3-1 Confirmation at CIMH 3-2 Confirmation of Web 3-3 Data of CIMH 3-4 Data of CIMH	
(Activities) 1.1 Development and production of hydrological and meteorological observation equipment and start of observation at the five(5) pilot sites (including telemetry systems for large basins in Guyana and Belize) 1.2 Development of GIS database at the five(5) pilot sites 1.3 Flood analysis at the five(5) pilot sites 1.4 Preparation of FHMs for each of the five(5) pilot sites showing inundation areas, shelters, evacuation routes etc. 1.5 Information collection on the communities at the five(5) pilot sites for preparing CDMPs 1.6 Preparation of CDMPs at the five(5) pilot sites 1.7 Establishment of FEWS at the five(5) pilot sites 1.8 Disaster evacuation training at the five(5) pilot sites based on CDMP 1.9 Implementation of Disaster Imagination Game (DIG) at the pilot sites 1.10 Training in Japan of the NTs counterparts about hydrological observation and CDMP	(Inputs) **Japanese side** - Dispatch of short-term experts (Flood analysis, Hazard mapping, GIS/Data base management, DIG, dispatched when necessary) - Training of counterpart personnel in Japan (5-6 persons annually) - Provision of equipment (Observation equipment, Data base related equipment, etc) **CDEMA side** - Assignment of counterpart personnel (RT, NT) - Provision of the office and facilities for the Japanese experts Regional Team - CDEMA (Caribbean Disaster Emergency Management Agency) - CIMH (Caribbean Institute of Meteorology and Hydrology) - UWI (University of the West Indies)		
2.1 Revision of the manual for FH mapping prepared in Phase 1 based on the result of activities at the five(5) pilot sites (including the establishment of cartographic standards for FH mapping) 2.2 Revision of the manual for CDMP prepared in Phase 1 based on the result of activities at the five(5) pilot sites 2.3 Preparation of the manual for FEWS 2.4 Hold workshops and seminars on FEWS 2.5 Training in Japan of the RT and/or NT counterparts in FH mapping, CDM planning, FEWS establishing, and DIG facilitation	National Team (Disaster agencies of pilot countries and Communities of pilot sites) - Belize - Commonwealth of Dominica - Grenada - Republic of Guyana - Saint Lucia		(Pre-Conditions) - Counterparts are assigned as planned and scheduled. - Project budget is allocated as planned and scheduled.

3.1 Evaluation of the status of hydrological data collection and management 3.2 Development of a web-based data collection, management and dissemination program 3.3 Procurement and installation of the computer equipment, software and peripherals for collection and dissemination of hydrological data at the regional and national levels 3.4 Training on input and dissemination of hydrological data at the regional and national levels.		

Table 2-1 Project Design Matrix (2/2): Revised PDM

Project Name: Caribbean Disaster Management Project Phase 2
Implementing Agency: Caribbean Disaster Emergency Response Agency (CDEMA)
Duration: From January 2009 to December 2011
Prepared on: 20 July 2011

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
(Super Goal) Disaster damage in CDEMA participating states is mitigated.	- Annual number of affected persons in CDEMA participating states will become under a targeted number. - Annual amount of property/business losses in CDEMA participating states will become under a targeted amount.	Disaster information of CDEMA participating states	
(Overall Goal) Disaster damages in CDEMA participating States are mitigated through enhancement of community resilience to the flood hazard (Similar project is implemented in flood vulnerable areas other than pilot sites of CDEMA participating states).	- Among the flood vulnerable areas in CDEMA participating states, FHMs are prepared for areas of more than 10%. - Among the flood vulnerable areas in CDEMA participating states, CDMPs are prepared for areas of more than 10%.	- CDEMA's Annual Reports - Interview to CDEMA participating states	- Comprehensive Disaster Management Plan of CDEMA is implemented.
(Project Purpose) Capacity of CDEMA and five pilot states for managing the flood risk is increased (RT has the capacity to establish FEWS in a flood vulnerable area with use of FHM and CDMP prepared by RT with the cooperation of NT).	- At more than half of the pilot sites, FHMs and CDMPs are prepared and FEWSs are prepared by RT with the cooperation of NT. - Concrete sustainability plans of RT and NT for maintaining the technical capacity and organizational system are prepared. - Action plan is prepared for preparation of FHM, CDMP and FEWS in flood vulnerable area other than the pilot sites.	- Project reports - Sustainability plans	- Disaster Policies of the Caribbean community are not largely changed. - CDEMA and disaster agencies of member states are properly budgeted and staffed. - No rapid change in natural environment will occur.
(Outputs) 1. FHMs are prepared, CDMPs are prepared and implemented, FEWSs are established and implemented at the pilot sites.	1-1 FHMs are prepared at all the pilot sites. 1-2 CDMPs are prepared at all the pilot sites. 1-3 FEWSs are established at all the pilot sites.	1-1 Project Reports 1-2 Project Reports 1-3 Project Reports	- Counterparts who received technical transfer continue to stay in CDEMA, RT and NT.
2. Capability of RT to develop FHM and to establish FEWS is upgraded.	2-1 FH mapping manual is revised more than once a year reflecting the activities in the pilot sites. 2-2 CDM planning manual is revised reflecting the activities at the pilot sites. 2-3 FEWS establishing Manual is prepared and distributed to all related agencies. 2-4 Workshop for establishing FEWS with use of FHM and CDMP is held more than once a year.	2-1 Revised Manual 2-2 Revised Manual 2-3 Project Reports 2-4 Project Reports	
3. Hydrological database is established and functioning at CIMH (Efficient	3-1 Hydrological data base is established at CIMH.	3-1 Confirmation at CIMH	

and effective use of the hydrological database becomes possible for FH mapping and FEWS establishing).	3-2 Web based-hydrological data collection, management and sharing program is developed. 3-3 Hydrological data is supplied from CDEMA member states through the program more than 50 times a year. 3-4 The hydrological data base through the program is accessed by CDEMA member states more than 50 times a year.	3-2 Confirmation of Web 3-3 Data of CIMH 3-4 Data of CIMH	
(Activities) 1.1 Development and production of hydrological and meteorological observation equipment and start of observation at the five(5) pilot sites (including telemetry systems for large basins in Guyana and Belize) 1.2 Development of GIS database at the five(5) pilot sites 1.3 Flood analysis at the five(5) pilot sites 1.4 Preparation of FHMs for each of the five (5) pilot sites showing inundation areas, shelters, evacuation routes etc. 1.5 Information collection on the communities at the five(5) pilot sites for preparing CDMPs 1.6 Preparation of CDMPs at the five(5) pilot sites 1.7 Establishment of FEWS at the five(5) pilot sites 1.8 Disaster evacuation training at the five(5) pilot sites based on CDMP 1.9 Implementation of Disaster Imagination Game (DIG) at the pilot sites 1.10 Training in Japan of the NTs counterparts about hydrological observation and CDMP	(Inputs) **Japanese side** - Dispatch of short-term experts (Flood analysis, Hazard mapping, GIS/Data base management, DIG, dispatched when necessary) - Training of counterpart personnel in Japan (5-6 persons annually) - Provision of equipment (Observation equipment, Data base related equipment, etc) **CDEMA side** - Assignment of counterpart personnel (RT, NT) - Provision of the office and facilities for the Japanese experts Regional Team - CDEMA (Caribbean Disaster Emergency Management Agency) - CIMH (Caribbean Institute of Meteorology and Hydrology) - UWI T&T (University of the West Indies, Trinidad & Tobago) - UG (University of Guyana) National Team (Disaster agencies of pilot countries and Communities of pilot sites) - Belize - Commonwealth of Dominica - Grenada - Republic of Guyana - Saint Lucia	
2.1 Revision of the manual for FH mapping prepared in Phase 1 based on the result of activities at the five(5) pilot sites (including the establishment of cartographic standards for FH mapping)		(Pre-Conditions)
2.2 Revision of the manual for CDMP prepared in Phase 1 based on the result of activities at the five(5) pilot sites 2.3 Preparation of the manual for FEWS 2.4 Hold workshops and seminars on FEWS 2.5 Training in Japan of the RT and/or NT counterparts in FH mapping, CDM planning, FEWS establishing, and DIG facilitation 2.6 Preparation of sustainability plans for maintaining the technical capacity and organizational system on FH mapping, CDM planning and FEWS establishing 2.7 Preparation of action plan for extending the activities to flood vulnerable areas other than the pilot sites based on the result of activities at the five (5) pilot sites.		- Counterparts are assigned as planned and scheduled. - Project budget is allocated as planned and scheduled.
3.1 Evaluation of the status of hydrological data collection and management 3.2 Development of a web-based data collection, management and dissemination program		

3.3 Procurement and installation of the computer equipment, software and peripherals for collection and dissemination of hydrological data at the regional and national levels 3.4 Training on input and dissemination of hydrological data at the regional and national levels.		

2.2 Implementing Arrangement

In implementation of the Project, the organization setup is basically the same with that of Phase 1 stage. The basic framework of the Project is that the Project activities to be conducted by the regional team (RT) and the national team (NT) with the support of JICA Team. JICA team members are based in Barbados. RT members are based in Barbados, Trinidad and Tobago, and Guyana. JICA team members and RT members visit the pilot sites depending on the necessity and work together with NT members of the pilot site states. Close contact to each other is kept with periodical reporting of progress and achievements other than close contact according to need.

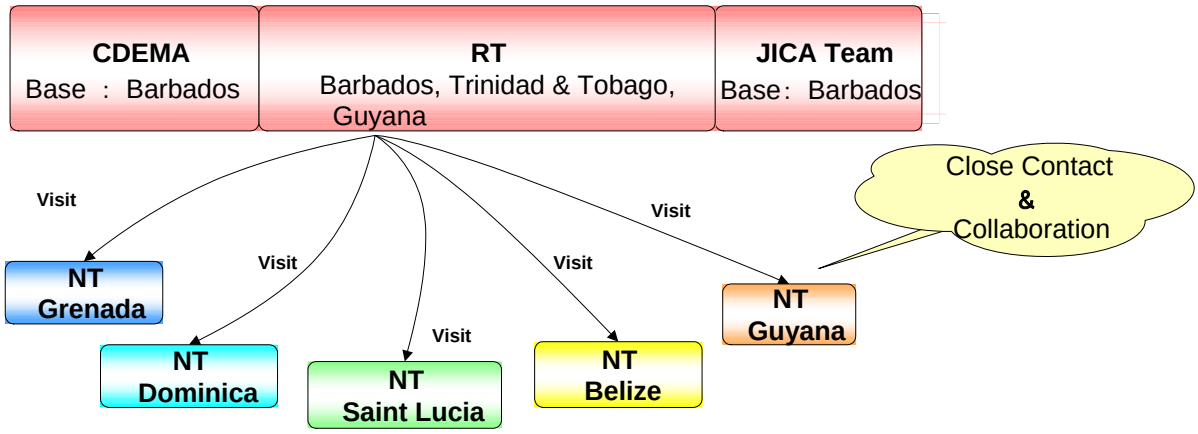


Fig. 2-1 Player of the Project

The organization of the Caribbean side is composed of the following:

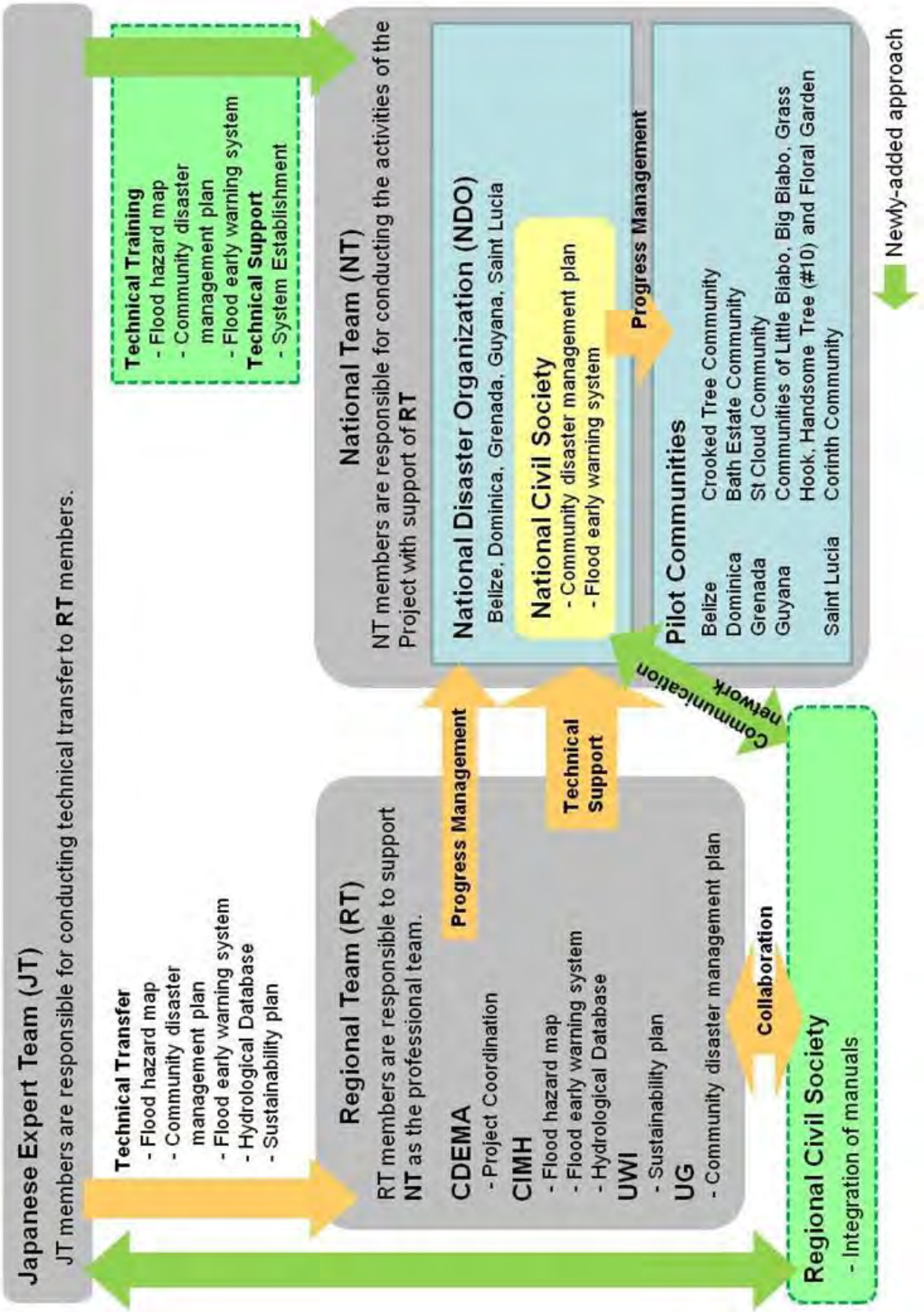
- CDEMA: Previously it was CDERA (Caribbean Disaster Emergency Response Agency), but now the name of the organization has been changed to CDEMA (Caribbean Disaster Emergency Management Agency).
- RT (Regional team): Previously it was composed of CDERA, UWI (University of the West Indies), and CIMH (Caribbean Institute of Meteorology and Hydrology), but now it is composed of CDEMA, CIMH, UWI, and UG (University of Guyana). Here UG is a new member of RT in phase 2, since UG was not a member of RT in phase 1.
- NT (National Team): It is comprised of the national implementation committees of the pilot states. The pilot states are Belize, Commonwealth of Dominica, Grenada, Guyana, and Saint Lucia in the Phase 2 of Caribbean Disaster Management Project.

In order to promote effective and smooth implementation of the Project, the Joint Coordination Committee (JCC) was set up with JICA, CDEMA, RT and NTs of the pilot states. Through the project implementation, the JCC meeting was held six times. Minutes of the JCC meetings are shown in Appendix-1.
In addition to the JCC meetings, the annual seminars and the intermediate meetings of the JCC members were held. The major meetings and seminars are summarized in Table 2-2.

Table 2-2 List of Major Meetings and Seminars

Date	Type	Venue	Outline
Feb. 18, 2009	Seminar	Barbados	Inception Report
Apr. 30, 2009	JCC Meeting (1st)	Barbados	Detailed implementation plan
Mar. 10, 2010	Annual seminar	Barbados	Flood hazard mitigation in the Caribbean states and progress of the Project
Mar. 11, 2010	JCC Meeting (2nd)	Barbados	Progress and schedule of the Project
Dec. 11. 2010	Mid-term meeting	Jamaica	Progress and schedule of the Project
Mar. 15, 2011	Annual seminar	Barbados (Accra Beach Hotel)	Roles of structural measures and non-structural measures in flood hazard mitigation
Mar. 16, 2011	JCC meeting (3rd)	Barbados (Accra Beach Hotel)	Progress and schedule of the Project
Aug. 30, 2011	Mid-term meeting	Barbados (CDEMA conference room)	Flood hazard mapping manual, flood early warning system manual and sustainability plan
Dec. 05, 2011	Seminar	Trinidad & Tobago	Seminar of flood early warning system for the Project in Caribbean Disaster Management (CDM) Conference
Aug. 31, 2011	JCC meeting (4th)	Barbados (Accra Beach Hotel)	Result of the Terminal Evaluation of the Project by JICA.
Dec. 14, 2011	JCC meeting (5th)	Barbados (Accra Beach Hotel)	JICA proposal on modification of implementation arrangement of the Project.
Jun. 05, 2012	Annual seminar	Barbados (Accra Beach Hotel)	All results of the Project, including lessons learnt.
Jun. 06, 2012	JCC meeting (6th)	Barbados	Sustainability plan of the Project.

At the 5th JCC Meeting, a change of implementing structure for more effective implementation of activities was proposed and agreed. The agreed structure is as shown below:


Japanese Expert Team (JT)
JT members are responsible for conducting technical transfer to RT members.
Technical Transfer
- Flood hazard map
- Community disaster management plan
- Flood early warning system
- Hydrological Database
- Sustainability plan
Technical Training
- Flood hazard map
- Community disaster management plan
- Flood early warning system
Technical Support
- System Establishment
National Team (NT)
NT members are responsible for conducting the activities of the Project with support of RT
National Disaster Organization (NDO)
Belize, Dominica, Grenada, Guyana, Saint Lucia
National Civil Society
- Community disaster management plan
- Flood early warning system
Progress Management
Pilot Communities
Belize Crooked Tree Community
Dominica Bath Estate Community
Grenada St Cloud Community
Guyana Communities of Little Biabo, Big Biabo, Grass Hook, Handsome Tree (#10) and Floral Garden
Saint Lucia Corinth Community
Newly-added approach
Regional Team (RT)
RT members are responsible to support NT as the professional team.
CDEMA
- Project Coordination
CIMH
- Flood hazard map
- Flood early warning system
- Hydrological Database
UWI
- Sustainability plan
UG
- Community disaster management plan
Progress Management
Technical Support
Communication network
Collaboration
Regional Civil Society
- Integration of manuals

2.3 Planned and Actual Activities

The Project activities in the Caribbean region were planned to be conducted from February 2009 to December 2011. However, the Terminal Evaluation Team dispatched to the Caribbean Region in August 2011 decided to extend the project period by six (6) months with the following reasons.

To achieve the project purpose as designed, the project will be extended for another 6 months which is equal to the delayed period of the establishment of FEWS.

The major activities of the Project are as follows:

CBDMP
This is the activity to prepare the community-based disaster management plan and the plan should be the basic plan for mitigation of flood disaster of the community.

FEWS
This is the activity to establish the flood early warning system of the community. This would contribute to CBDMP for smooth implementation of the CBDMP with some lead time for the evacuation of the community people.

FHM
This is the activity to prepare the flood hazard map. This map would also contribute to CBDMP for clear understanding of the community to input the community about, to what extent the inundation would take place, where to evacuate and to where the people should evacuate.

Hydrological Database
This is the activity to establish the hydrological database at CIMH. This would contribute to the planning and designing for the flood disaster mitigation countermeasures for all NTs.

Institutionalization of NT
For the sustainability of the Project, institutionalization of NT is the vital part. Without the institutionalization of NT, the sustainability of the project could not be guaranteed for each state of CDEMA Participating State.

Sustainability Plan
Preparation of the sustainability plan is also the vital part of the Project. Without the plan, any activity of flood disaster mitigation activities could not be guaranteed after the CADM2 project is terminated.

The flow chart of the project implementation is shown in Fig. 2-2. The planned and actual periods of the activities of the project are also shown in Fig. 2-3.

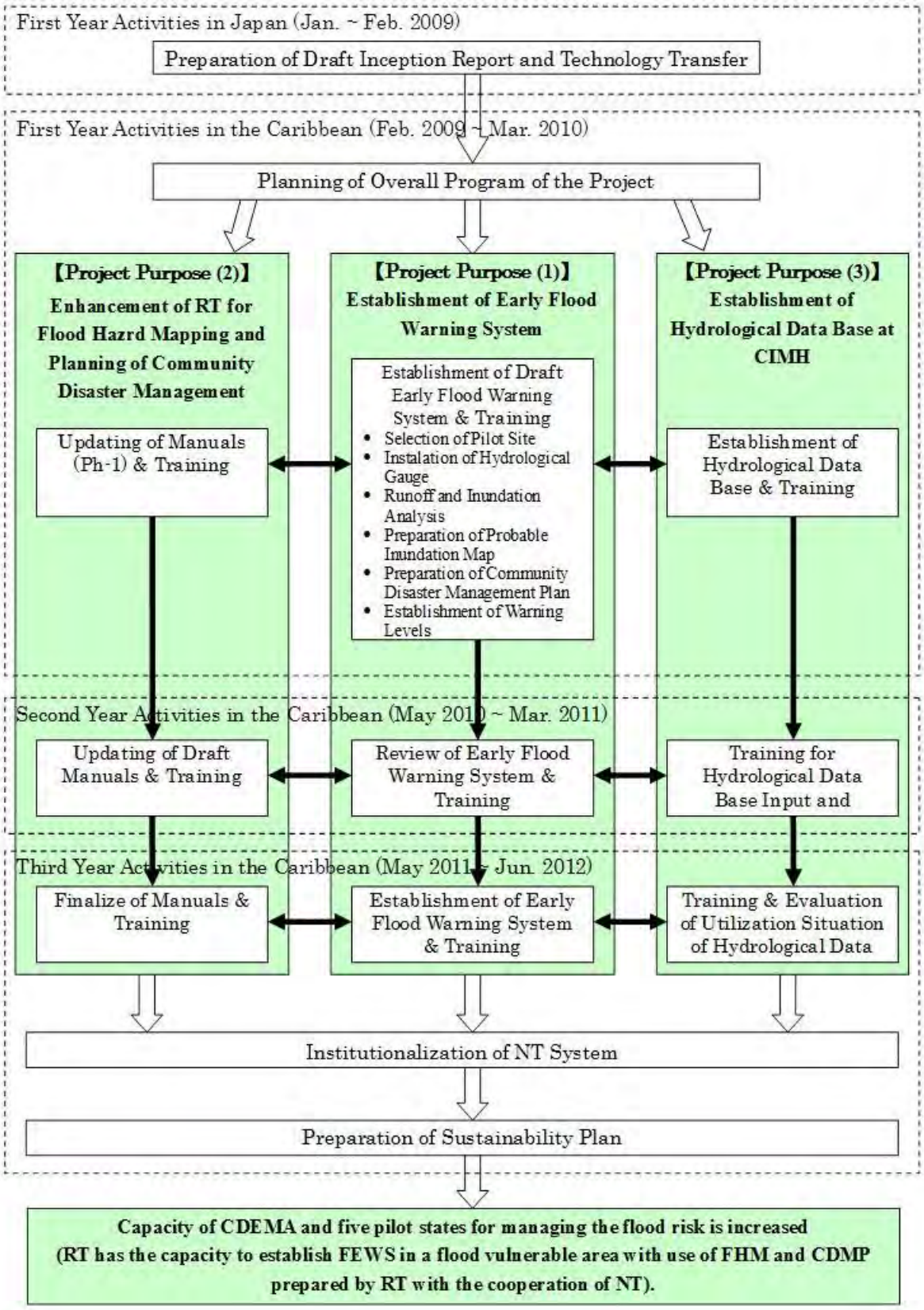
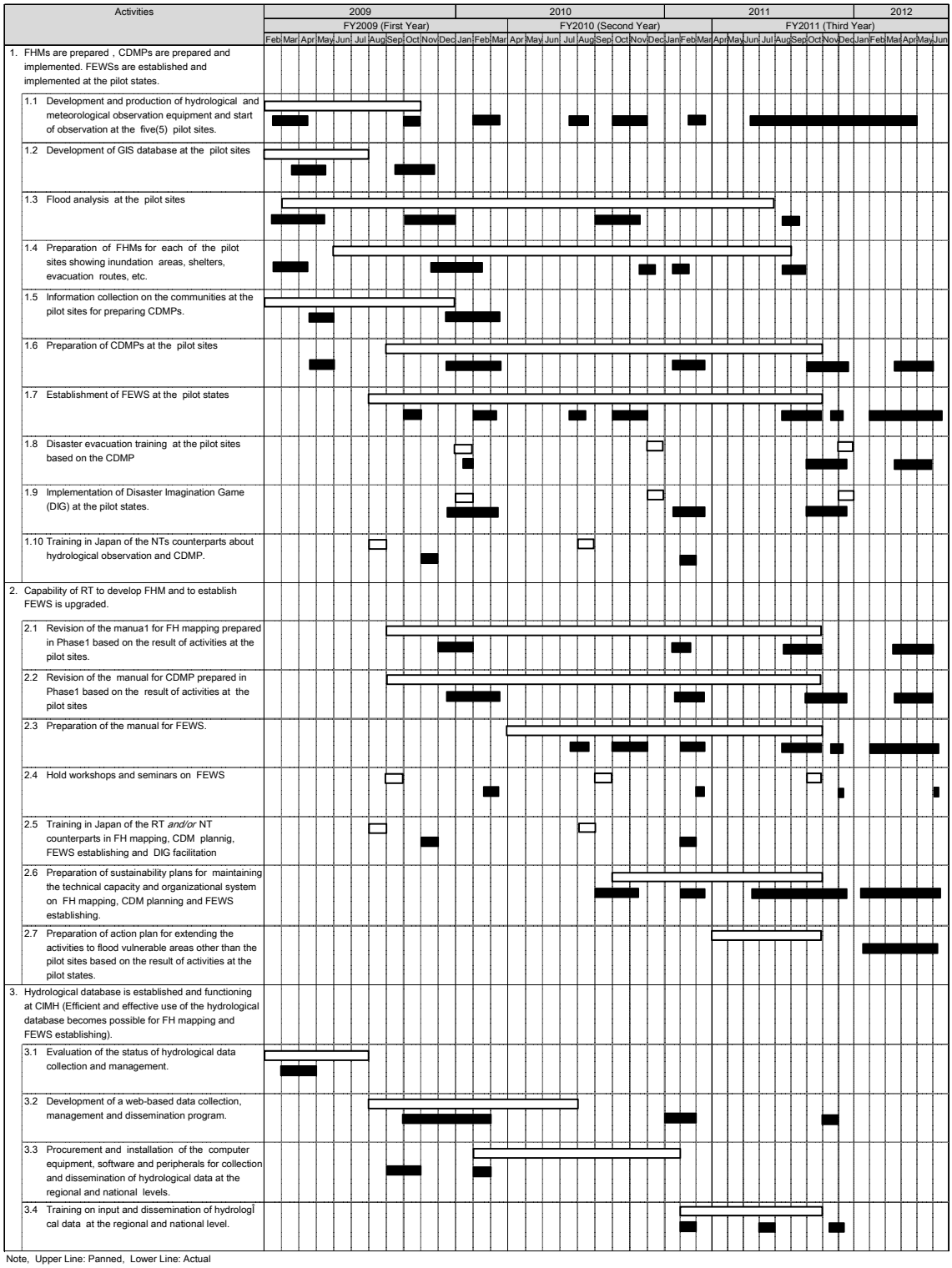


Fig. 2-2 Flow Chart of the Project Implementation



Note, Upper Line: Panned, Lower Line: Actual

Fig. 2-3 Planned and Actual Period of Activities

2.4 Input of Japanese Side

2.4.1 Dispatch of Experts

The JICA team that consists of seven (7) experts was dispatched to the project sites. The assignment periods of each expert are summarized in Table 2.3.

Table 2-3 Summary of Assignment Periods of JICA Experts

No.	Name	Position	Year	Period		
				from	to	Day
1	Toshikatsu IMAI	Chief Advisor/Early Flood Warning System	1st	2009/02/14	2009/04/06	52
				2009/04/26	2009/05/08	13
				2009/09/30	2009/10/29	30
				2010/01/27	2010/03/16	49
			2nd	2010/07/11	2010/08/09	30
				2010/09/24	2010/12/14	82
				2011/02/03	2011/03/20	46
			3rd	2011/08/15	2011/10/19	66
				2011/11/10	2011/12/18	39
				2012/02/01	2012/06/14	135
			total			542
2	Noboru JITSUHIRO	Flood Analysis	1st	2009/02/14	2009/05/14	90
				2009/09/30	2009/12/28	90
			2nd	2010/08/22	2010/11/14	85
			3rd	2011/08/13	2011/09/11	30
			total			295
3	Hideki ARAKI	Flood Hazard Mapping	1st	2009/02/14	2009/03/15	30
				2009/11/12	2010/02/09	90
			2nd	2010/11/13	2010/12/12	30
				2011/01/24	2011/02/17	25
			3rd	2011/08/13	2011/10/02	51
				2012/03/16	2012/06/09	86
			total			312
4	Lolita C. GARCIA	Community Disaster Management	1st	2009/03/26	2009/05/26	62
				2009/12/16	2010/03/13	88
			2nd	2010/01/11	2010/02/17	38
				2010/03/01	2010/03/22	22
			3rd	2011/09/30	2011/12/13	75
				2012/03/28	2012/06/10	75
			total			360
5	Toru KOIKE	Hydrological Database/GIS	1st	2009/03/16	2009/05/14	60
				2009/09/14	2009/12/27	105
			2nd	2011/02/09	2011/03/10	30
			3rd	2011/07/06	2011/08/04	30
				2011/11/04	2011/12/03	30
			total			255
6	Yosuke USUI	Installation of Hydrological Gauges	3rd	2011/06/12	2011/07/11	30
				2012/01/14	2012/04/10	88
			total			118
7	Osamu NAKAZAWA	NT Structure Enhancement	3rd	2011/12/01	2011/12/18	18
				2012/01/14	2012/04/10	88
			total			106
		Coordinator	1st	2009/02/07	2009/03/08	30
				2009/08/29	2009/09/12	15
				2010/03/01	2010/03/15	15
			2nd	2010/06/16	2010/07/15	30
				2011/02/26	2011/03/27	30
			3rd	2011/06/12	2011/09/03	84
				2012/05/01	2012/06/14	45
			total			249
Number of Experts 7			Total			2,237

Aiming to achieve the project purpose and to enhance the institutionalization of NT for the sustainability of the project, two (2) experts of "Installation of Hydrological Gauges" and "NT Structure Enhancement" were additionally dispatched to the project during the 3rd year including 6 months extension period.

2.4.2 Acceptance of Trainees

Counterpart training in Japan was conducted twice as shown in Table 2-4.

Table 2-4 Counterpart Training in Japan

No.	Duration	Title of Training	Participant
1	Feb. 14, 2010 – Mar. 12, 2010 (27 days)	Flood Analysis/Community Based Disaster Management	NT: 5 trainees Belize (Mr. PARHAM Harriet Kenton) Dominica (Mr. CORRIETTE Don Arnold) Grenada (Mr. JONES Kem Kendon) Guyana (Mr. CRAIG Kester Romero) Saint Lucia (Mr. DU BOIS Julian)
2	Feb. 01, 2011 – Feb. 18, 2011 (18 days)	Disaster management in Japan	RT: 4 trainees CIMH (Ms. Cherie Pounder) CDEMA (Mr. Ricardo Yearwood) UG (Dr. Paulette Bynoe) UWI (Dr. Jacob Opadeyi)

Training in the Caribbean region was conducted three (3) times as shown in Table 2-5

Table 2-5 Counterpart Training in Caribbean Region

No.	Duration	Contents/Venue	Participant
1	Dec. 7, 2009 – Dec. 11, 2009 (5 days)	GIS Training Course (CIMH in Barbados)	RT: 11 trainees CIMH and others
2	Mar. 7, 2011 – Mar. 11, 2011 (5 days)	Flood hazard Mapping Course (CIMH in Barbados)	NT: 9 trainees Grenada (1), Guyana (2), Saint Lucia (2), Dominica (2), Belize (2)
3	Jun. 4, 2012 (1 day)	Installation, maintenance & operation, downloading data of the gauges	NT and officials from CARICOM member states

In addition to the above training, JICA experts and members of RT were conducted the training seminar/workshop to the members of NT during their country missions.

2.4.3 Provision of Equipment

In order implement the Project, the following equipment was procured and allocated to CIMH and the pilot states.

Table 2.6 List of Equipment

No.	Item	Unit	Purpose	Allocation	Procurement	Time of delivery
1	PC: SONY VAIO	1	Flood analysis, Flood hazard map preparation	CIMH (1)	Procurement in Barbados	October 2009
2	PC: DELL OPTIPLEX	1	Flood analysis, Flood hazard map preparation	CIMH (1)	Procurement in Barbados	October 2009
3	Printer: HP Color LJCM	1	Flood analysis, Flood hazard map preparation	CIMH (1)	Procurement in Barbados	November 2009
4	Printer: HP Color K8600	1	Flood analysis, Flood hazard map preparation	CIMH (1)	Procurement in Barbados	January 2010
5	Software: ArcView	1	Flood analysis, Flood hazard map preparation	CIMH (1)	online	November 2009
6	Software: FLO-2D	1	Flood analysis, Flood hazard map preparation	CIMH (1)	online	December 2009
7	Transceiver	20	CBDRM, Evacuation	Belize (4) Dominica (4) Grenada (4) Guyana (4) St. Lucia (4)	Procurement in Barbados (12), Belize (4) and Guyana (4)	Nov, Dec,. 2009 Jan. 2010
8	Portable Megaphone	13	CBDRM, Evacuation	Belize (3) Dominica (2) Grenada (2) Guyana (3) St. Lucia (3)	Procurement in Barbados	November 2009
9	Hydrological gauges(1st lot): WL (8), R (6) and appurtenances	14	EFWS, Data collection	Belize (WL:2) Dominica (WL:1, R:2) Grenada (WL:1, R:2) Guyana (WL:2, R1) St. Lucia (WL:2, R:1)	Procurement from USA	January 2011
10	Hydrological gauges(2nd lot): WL (3) and other appurtenances	3	EFWS, Data collection	Belize (WL:2) Guyana (WL:1)	Procurement from USA	July 2011, Sep.2011
11	Software FLO-2D Latest version upgrade	1	Flood analysis, Flood hazard map preparation	CIMH (1)	online	July 2011
12	Laptop PC: Lenovo	5	EFWS, Data collection	Belize (1) Dominica (1) Grenada (1) Guyana (1) St. Lucia (1)	Procurement in Barbados	November 2011
13	Hydrological gauges(Additional): R (1) and appurtenances	1	EFWS, Data collection	Belize (R:1)	Procurement from USA	March 2012

2.4.4 Local Costs borne by Japanese Side

The local cost borne by Japanese side is summarized as shown in Table 2-7. The total amount of local costs or operation expenses is 109.1 million Yen for 3.5 years. Major expenses are travel expense (55.7 million Yen), sub-contract cost for survey & construction (22.3 million Yen) and procurement cost of equipment (13.1 million Yen).

Table 2.7 List of Local Costs borne by Japanese Side

unit: JPY

Items	FY 2009: 1st Year (Settled Cost) I	FY 2010 2nd year (Settled Cost) II	FY 2011 3rd year (Contract Cost) III	Total (I+II+III)	Remarks
(1) General Cost	10,680,783	10,165,709	52,043,352	72,889,844	66.84%
[1] Staff Cost	1,764,466	1,945,534	4,028,001	7,738,001	7.10%
[2] Equipment Maintenance Cost	-	99,617	104,142	203,759	0.19%
[3] Consumable Cost	17,642	56,273	294,300	368,215	0.34%
[4] Travel Expense	7,816,858	7,344,824	40,520,979	55,682,661	51.06%
[5] Communication/transport Cost	-	-	-	-	-
[6] Document Preparation Cost	125,372	1,183	4,281,900	4,408,455	4.04%
[7] Rental Cost	600,045	718,278	2,814,030	4,132,353	3.79%
[8] Utility Cost	-	-	-	-	-
[9] Staff Training/Management Cost	-	-	-	-	-
[10] Facility Operation & Maintenance Cost	-	-	-	-	-
[11] Local Training Cost	-	-	-	-	-
[12] Activity Cost in Japan	-	-	-	-	-
[13] Sub-contruct Cost in Japan	-	-	-	-	-
[14] Miscellaneous Cost	356,400	-	-	356,400	0.33%
(2) Equipment Cost (for JICA Expert)	2,165,000	4,979,000	5,962,000	13,106,000	12.02%
(3) Equipment Cost (others)	246,000	212,000	163,000	621,000	0.57%
(4) Report Preparation Cost (Printing & Binding)	-	-	129,000	129,000	0.12%
(5) Report Preparation Cost (except Printing & Binding)	-	-	44,000	44,000	0.04%
(6) Sub-contract Cost	17,342,000	1,655,000	3,269,000	22,266,000	20.42%
Total	30,433,783	17,011,709	61,610,352	109,055,844	100.00%

2.5 Input of Caribbean Side

2.5.1 Assignment of Counterpart Personnel

(1) RT Members
RT members are composed of CDEMA, CIMH, UWI and UG as follows:

Table 2-8 RT Members

Name	Major Role	Organization
Mr. Jeremy Collymore	Project Director	CDEMA
Ms. Elizabeth Riley	Project Manager	CDEMA
Ms. Roxanne Boyce	Secretary	CDEMA
Dr. Jacob Opadeyi	GIS / Sustainability Plan	UWI
Dr. David Farrell	Hydrological Database	CIMH
Dr. Trevor Jackson	Disaster Management	UWI
Dr. Paulette Bynoe	Community Disaster Management	UG
Mr. Shawn Boyce	Flood Analysis / Flood Hazard Map / Flood Early Warning System	CIMH
Miss Cherie Pounder	Flood Analysis / Flood Hazard Map / Installation of Hydrological Gauges	CIMH

(2) NT Members
NT members are assigned from the pilot states, that is, Belize, Dominica, Grenada, Guyana and Saint Lucia. Main NT members are as follows:

Table 2-9 NT Members

State	Member	Remarks
Belize	National Emergency Management Organization (NEMO)	Main C/P Agency for NT Structure Enhancement
	National Meteorological Service	
	Land and Information Center	
	National Association of Village Council	
	Crooked Tree Community	
	Belize Red Cross Society	
Dominica	Office of Disaster Management (ODM)	Main C/P Agency for NT Structure Enhancement
	Meteorological Services	
	Physical Planning Division	
	Land and Survey Division	
	Bath Estate Community	
	Dominica Red Cross Society	
Grenada	National Disaster Management Agency (NaDMA)	Main C/P Agency for NT Structure Enhancement
	National Water Resources & Sewerage Authority	
	Land Use Division, Ministry of Agriculture	
	Physical Planning Unit, Ministry of Works	
	Balthazar Village Community	
	Grenada Red Cross Society	
Guyana	Civil Defense Commission (CDC)	Main C/P Agency for NT Structure Enhancement
	Hydro meteorological Service, Ministry of Agriculture	
	Lands & Survey Commission, Ministry of Agriculture	

	Upper Mahica Community	
	Guyana Red Cross Society	
Saint Lucia	National Emergency Management Organization (NEMO)	Main C/P Agency for NT Structure Enhancement
	Water Resources Management Authority	
	Meteorological Services, Ministry of Infrastructure	
	Survey and Mapping Section, Ministry of Planning	
	Physical Planning Section, Ministry of Physical Development	
	Corinth Community	
	Saint Lucia Red Cross	

2.5.2 Provision of Office and Facilities for JICA Experts

CDEMA and CIMH in Barbados provided the office space with facilities to the JICA Team. Three (3) experts (Chief Advisor, Hydrological Gauge Installation and Coordinator) are housed in CDEMA. The other 4 experts are housed in CIMH.

2.6 Outputs of the Project

Outputs of the Project are tabulated as shown in Table 2-10, based on the narrative indicators described in the PDM.

Table 2-10 List of Outputs of the Project

Output /Objectively Verifiable Indicators in PDM		Achieved Status
Overall Goal)	Disaster damages in CDEMA participating States are mitigated through enhancement of community resilience to the flood hazard (Similar project is implemented in flood vulnerable areas other than pilot sites of CDEMA participating states).	
• Among the flood vulnerable areas in CDEMA participating states, FHMs are prepared for areas of more than 10%. • Among the flood vulnerable areas in CDEMA participating states, CDMPs are prepared for areas of more than 10%.		List of Flood Vulnerable Communities and Monitoring Matrix for each pilot state are prepared and attached in draft MOUs. By using these materials, progresses of rerated activities of each Caribbean state and donors will be organized well.
Project Purpose	Capacity of CDEMA and five pilot states for managing the flood risk is increased (RT has the capacity to establish FEWS in a flood vulnerable area with use of FHM and CDMP prepared by RT with the cooperation of NT).	
• At more than half of the pilot sites, FHMs and CDMPs are prepared and FEWSs are prepared by RT with the cooperation of NT		Achieved: At the all pilot sites, FHMs and CDMPs are prepared and FEWSs are prepared by RT with the cooperation of NT.
• Concrete sustainability plans of RT and NT for maintaining the technical capacity and organizational system are prepared.		Achieved: Proposed "Sustainability Plan" is approved in the JCC meeting held on June 06, 2012.
• Action plan is prepared for preparation of FHM, CDMP and FEWS in flood vulnerable area other than the pilot sites		Achieved: Proposed "Implementation Schedule (Action plan)", as a part of "Sustainability Plan", is approved in the JCC meeting held on June 06, 2012.

Output /Objectively Verifiable Indicators in PDM		Achieved Status
Output 1:	FEWSs are established and implemented at the pilot sites.	
1-1	FHMs are prepared at all the pilot sites.	Achieved: FHMs of the pilot sites were prepared and refined through the community participation of the pilot sites.
1-2	CDMPs are prepared at all the pilot sites.	Achieved: CDMPs of the pilot sites were developed by the residents of the pilot sites.
1-3	FEWSs are established at all the pilot sites.	Achieved: All of the gauges were installed and set up to April, 2012. Although some stations (in Guyana and Dominica) have problems on telecommunication network, FEWS were established at all the pilot sites and are under operation.
Output 2:	Capability of CDEMA and 5 pilot states to develop FHM and to establish FEWS is upgraded.	
2-1	FH mapping manual is revised more than once a year reflecting the activities in the pilot sites.	Achieved: The existing manual, an output of the phase 1, was revised in the 2nd year to include “Annex: Technical Approach” and “Annex: Community Flood Hazard Mapping” in reflect of phase 2 activities. The manual was finalized in 3rd year, reflecting the demands from the residents of the pilot sites.
2-2	CDM planning manual is revised reflecting the activities at the pilot sites.	Achieved: The existing manual, an output of the phase 1, was revised in the 1st year to include detailed procedure for community-based disaster management planning. In the 2nd year, it was revised again to include experience of community planning in pilot sites of Phase 2. In the 3rd year, it was finalized, to include experience of community planning in pilot sites.
2-3	FEWS establishing Manual is prepared and distributed to all related agencies.	Achieved: In the 2nd year, the 1st draft manual was prepared, describing how the warming could be made. Procedures as who receives the first signal and the subsequent communication line are prepared as one of the outputs of CBDRM. The draft manual was distributed to all the concerning agencies In the 3rd year the manuals was finalized including the example in the pilot states, and the finalized manual was explained in the seminar.
2-4	Workshop for establishing FEWS with use of FHM and CDMP is held more than once a year.	Achieved: In the 1st year, WS was conducted on (5 day) on the basic concept of the project. In the 2nd year, WS was conducted on (1 day) on the three manuals mentioned above. In the 3rd year, the seminar was conducted twice, at the CDM Conference in Trinidad & Tobago and at seminar on installation, operation and maintenance of gauges on June 04, 2012.

Output /Objectively Verifiable Indicators in PDM		Achieved Status
Output 3:	Hydrological database is established at CIMH and efficient and effective use of the hydrological database becomes possible for FH mapping and FEWS establishing.	
3-1	Hydrological data base is established at CIMH.	Achieved: In the 1st year, the database server was setup and its operation system was developed at CIMH. Two types of web-based hydrological databases are completed and in operation at present. 1) One is the automatic data-updating database which has a real-time linkage with existing web-based national database (NWIS) of Grenada and Guyana. 2) The other is replacement of current stand-alone database in CIMH. This database is for all CARICOM participating states where web-based database has not been developed.
3-2	Web based-hydrological data collection, management and sharing program is developed.	Achieved: The data collection, management and sharing program have been developed for each pilot country.
3-3	Hydrological data is supplied from CDEMA member states through the program more than 50 times a year.	Achieved : but not only via internet access through the program but also supplied manually by NT members in support of project activities and through the Data Rescue Project that was launched in 2011 by the CIMH. The Data Rescue Project activities include the consolidation of all the databases at the CIMH.
3-4	The hydrological data base through the program is accessed by CDEMA member states more than 50 times a year.	Achieved : The access counter is 204 at this time (as of the middle of may). Data can be viewed. Note that most of the data provided by countries are stored locally within the country. Therefore countries do not necessarily have to access the database to access their data. Full access to the rainfall database is only possible for administrators. Management of hydrological data by CDEMA member states must be promoted.

3. ACTIVITY AND ACHIEVEMENT

3.1 General

The activities of the Project in Caribbean region were commenced from February 2009 and terminated. The first year activities in the Caribbean region were carried out from February 2009 to March 2010, the second year activities from June 2010 to March 2011, and the third year activities from June 2011 to June 2012.

At the beginning of the first year, from February to March 2009, the JICA experts and members of RT (CDEMA, CIMH, and UG) conducted the country missions to the pilot states in order to discuss the schedule of the Project, to confirm the composition of members of NT, and to inspect the candidate pilot sites of the respective states.

Selection of Pilot Sites

The selection of pilot sites among proposed candidate sites was conducted by use of the following criteria and through the site reconnaissance and the discussion with RT and NT.

- Past flood damages
- Hydrological data availability
- Community's concern level to disaster management
- Availability of community's organization
- Site scale appropriateness as a pilot site
- Travel distance from the capital city

Belize
Proposed site was only Crooked Tree and in consideration of the criteria, the Crooked Tee was selected.

Dominica
Candidate sites were the Layou River and the Roseau River sites. In consideration that the inundation area of the Roseau River is a part of the capital city of Dominica, the Roseau River site was selected.

Grenada
Candidate sites were three sites and among them the Great River site was the most appropriate site since the flood took place in 2005 and 2006, and residential area was inundated in the floods and the area is a critical site since the beneficiaries are very many.

Guyana
Candidate sites were the Mahaicony River and the Mahaica River sites. The importance of the both river sites were nearly the same and in consideration that the Mahaicony River site is much far than the Mahaica River site, the Mahaica River site was selected as the pilot site.

Saint Lucia
Candidate sites were the Dennery River site, the Choc River site and the Bois D'Orange River sites. Among them, in consideration that the trunk road of the country connecting the capital city of Saint Lucia and the northern part of the country is located in the Bois D'Orange River basin, the Bois D'Orange River site was selected.

The selected pilot sites of the Project are shown in Table 3-1.

Table 3-1 Pilot site and Characteristics of the Project

Item	Belize	Dominica	Grenada	Guyana	Saint Lucia
Selected Pilot Community	Crooked Tree, Belize Rural,	Bath Estate, Roseau Valley,	Balthazar Village	Upper Mahaica Communities	Corinth, Gros Islet
River Basin	Belize River	Roseau River	Great River	Mahaica River	Bois d' Orange River
Population	985 of which about 150 are at risk to flooding	About 160 are at risk to flash flood			Not established at this time
Urban/ Semi urban / Rural	Rural	Urban	Rural	Rural	Urban
Location Context	Bounded by Northern, Western and Southern Lagoon	Bounded by Roseau River	Proximate to Great River, downstream of Grand Etang	Communities along the Mahaica River and proximate to the Demerara Water Conservancy	Intersected by Grand Riviere River (Bois D'Orange)
Major Livelihood	Agriculture/ Animal Husbandry, small businesses	Employment	Agriculture Animal Husbandry	Agriculture Animal Husbandry	Employment
Major hazard	Riverine Flood	Flash Flood River Bank Erosion	Flash Flood	Riverine Flood	Flash Flood
Hazard monitoring system	Water level gauge at northern lagoon	None	None	None	None
Warning Communication	Bull horn privately owned by a church in Crooked Tree	none	none	none	none

The outlines of the activities during the Project are summarized hereunder:

3.2 Flood Analysis

The results of the flood analysis conducted for the five (5) pilot basins were compiled into five (5) reports and explained and discussed with the members of the NT in the pilot states, respectively. Therefore, this section summarizes the activities and achievements of the flood analysis.

3.2.1 First Year

The activity related to the flood analysis in the first year is itemized as follows:

- Flood survey
- Land survey
- Flood analysis including data collection

Activities and achievements of the above items are summarized below:

(1) Flood survey

Flood survey aims to get data and information related to the past floods in the flood prone areas of the pilot river basins. Results of survey are used for flood analysis, flood hazard mapping and community disaster prevention.

Pilot river basins are divided into island and continental basins of markedly different physical features. The island basins such as (1) the Roseau River in Dominica, (2) the Great River in Grenada and (3) the Bois d' Orange River in Saint Lucia have small areas and steep slopes. (4) The Belize River Valley in Belize and (5) the Mahaica River in Guyana are located in the continent having larger basin areas with extremely mild slopes. The survey areas of respective pilot basins are summarized below

Table 3-2 Pilot River Basins

Country/ river (basin area)	Flood prone areas for flood survey
1. Dominica/ Roseau R. (32.5 km^2)	Areas along the Roseau R. downstream from Bath Estate in Roseau City.
2. Grenada/ Great R. (46.2 km^2)	Areas along the Great R. downstream from Castaign Bridge.
3. Saint Lucia/ Bios d' Orange R. (9.79 km^2)	Areas along the Bois d' Orange R. downstream from Grande Riviere including Corinth.
4. Belize/ Belize R. Valley (8,609 km^2)	Low-lying areas on the left bank of the Belize R. Valley such as Lemonal, Crooked Tree, Gardenia and Sand Hill.
5. Guyana/ Mahaica R. (1,453 km^2)	The areas along the Mahaica R. downstream from the Lama R. confluence.

Main work items of the flood survey are as follow:

1) Work-1: Determination of a target flood for the survey which is one of the most disastrous flood in recent 10 years.
2) Work-2: Collection of hydrological data of daily rainfall records, water level records, and other hydrological data related to the target flood.
3) Work-3: Interview to the residents in flood prone areas to collect information during the target flood such as flooding conditions and residents' coping activities. Location of interview site shall be recorded by use of GPS. Where flood marks of the target flood are found, their water levels shall be marked for the leveling survey later.
4) Work-4: Delineation of limit of inundated areas during the target flood.

Work quantities of the respective river basins are summarized as follow:

Table 3-3 Work Quantities of Flood Survey

River basin	Work quantities	
	Interviews	Flood marks
1. Roseau R. (Dominica)	25 sites	10 places
2. Great R. (Grenada)	25 sites	10 places
3. Bios d' Orange R. (Saint Lucia)	20 sites	10 places
4. Belize R. Valley (Belize)	45 sites	20 places
5. Mahaica R. (Guyana)	45 sites	20 places

Flood survey was carried out by the person hired in each pilot country. The survey was supervised by the JICA team and the relevant NT in collaboration, in line with the specifications prepared by the JICA team. Flood survey works were completed for all pilot basins, though the hiring procedures and work implementation delayed.

(2) Land Survey

The land survey aims to obtain cross sections of river channels and river structures, longitudinal profiles along the river (river survey), and topographic and flood mark data in the flood plain areas (flood plain survey). Results of these surveys are to be used for flood flow analysis, flood hazard mapping and community-based disaster management for the Project

Objective areas of the land survey for respective pilot basins are as shown in Table 3.4

Table 3-4 Objective Area of Land Survey

River basin (River length for survey)	Location
1. Roseau R. (3.7 km long)	Along the Roseau R. from Bath Estate to the river mouth and surrounding flood prone areas.
2. Great R. (11.8 km long)	Along the Great R. from Castaign Bridge to river mouth and surrounding flood prone areas.
3. Bios d' Orange R. (5.5 km long)	Along the Bois d' Orange R. from Grande Riviere to the river mouth and surrounding flood prone areas.
4. Belize R. Valley (94.1 km long)	Along the Belize R. from 1 km upstream of Big Falls station to the river mouth and surrounding flood prone areas.
5. Mahaica R. (32.5 km long)	Along the Mahaica R. from Lama R. confluence to the river mouth and surrounding flood prone areas.

The land survey covers following works:

1) Control Survey: To install temporary bench marks (TBM) in the surrounding areas of the survey works. The TBM shall be put on the permanent structures or newly installed concrete stakes at the convenient places for survey, and their locations should be clearly shown on the map/sketch. Horizontal coordinates and elevations of the TBM shall be linked with the nearest national bench marks (NBM).
2) River Survey:
   (1) River sections: Entire river channel and 50-m wide riverbanks on both sides.
   (2) Survey of river structures: Cross sections of structures which may affect the flood flows, showing elevations of bottom sill, size of opening for flood flow, and river channel and riverbank at the structure site.
3) Flood Mark Survey: Leveling survey of elevations of flood marks identified in the course of the flood survey, linked with any of the nearest stake of which elevation is known.
4) Preparation of Report
   (1) Preparation of report and drawings
   (2) Meetings in Barbados: Two meetings were scheduled in Barbados, one at the initial stage of

land survey to discuss on the survey program and schedule, and another at the final stage of the contract to submit outputs with explanation and finalize the work.

Quantities of works for the respective rivers are summarized in Table 3-5.

Table 3-5 Work quantities of Land Survey

Items	Unit	Roseau River	Great River	Bois d' Orange River	Belize River Valley	Mahaica River
1. Control Survey	l.s.	-	-	-	-	-
2. River Survey						
2.1 Cross section survey	section	19	24	28	20	33
2.2 Structural survey	bridge	5	6	4	3	2
3. Flood Plain Survey						
3.1 Structural survey (gates)	gate					5
3.2 Flood mark survey	place	10	10	10	20	20
4. Preparation of Report						
4.1 Preparation of Report	l.s.	-	-	-	-	-
4.2 Meetings in Barbados	trips	2	2	2	2	2

Local surveyors were selected for the land survey through the competitive bidding. The survey works were supervised in collaboration with the relevant NT and JICA team in line with the specifications prepared by the JICA team. Land survey works were completed for all pilot basins, though the bidding procedures and work implementation delayed.

In most pilot countries, bidding procedures and implementation of field surveys took a lot of time mainly due to the following reasons:

1) Agreement of Survey Fee: Budget available for the survey was limited intending to minimize the field survey costs, so that the project could be sustained by respective countries financed by the governments concerned. In order to keep the contract cost within the budget available, scope of work was adjusted. In case the shortage of flood data is recognized after the first year study, supplemental survey can be proposed for next year program.
2) Communications with E-mail: Since the pilot sites distribute over five countries, JICA Expert could not station in respective pilot countries. Therefore, the E-mails were the main communication measures with the NT and contractors. E-mail is a convenient tool, but it takes time to get mutual consent and sometimes it causes misunderstanding.

(3) Flood Analysis

Objective:
Flood analysis aims to establish a model which enables to simulate the flooding conditions of the past major flood, and to apply it to estimate physical features of probable floods which are for planning Early Flood Warning System (EFWS).

Flow of Analysis and Outline of Progress:
Flow of flood analysis for preparation of flood hazard map and community disaster management plan are presented in Fig. 3-1. The works are grouped into nine steps of works. Progress of these works in the first year is outlined below.

Works Completed by March 2010:
1) Preliminary site inspection and collection of basic data and information
2) Selection of pilot site

3) Preparation of plan and specifications for field survey works, i.e., flood survey and land survey.
4) Collection of data such as hydrological and topographic data
5) Execution of flood survey and land survey
6) Basic studies to provide input data for flood analysis which include rainfall analysis, basin analysis and channel flow analysis
7) Flood area maps of past flood disasters based on the flood survey results

Works Ongoing and to be Continued in Next Period:
8) Runoff analysis to establish runoff models and simulation of probable runoff hydrographs: Runoff will be analyzed applying HEC-HMS.
9) Flood flow analysis to establish flood flow models and simulation of probable flood flows: Flood flow will be analyzed applying FLO-2D or non-uniform flow model like HEC-RAS depending on the conditions of flood flow.

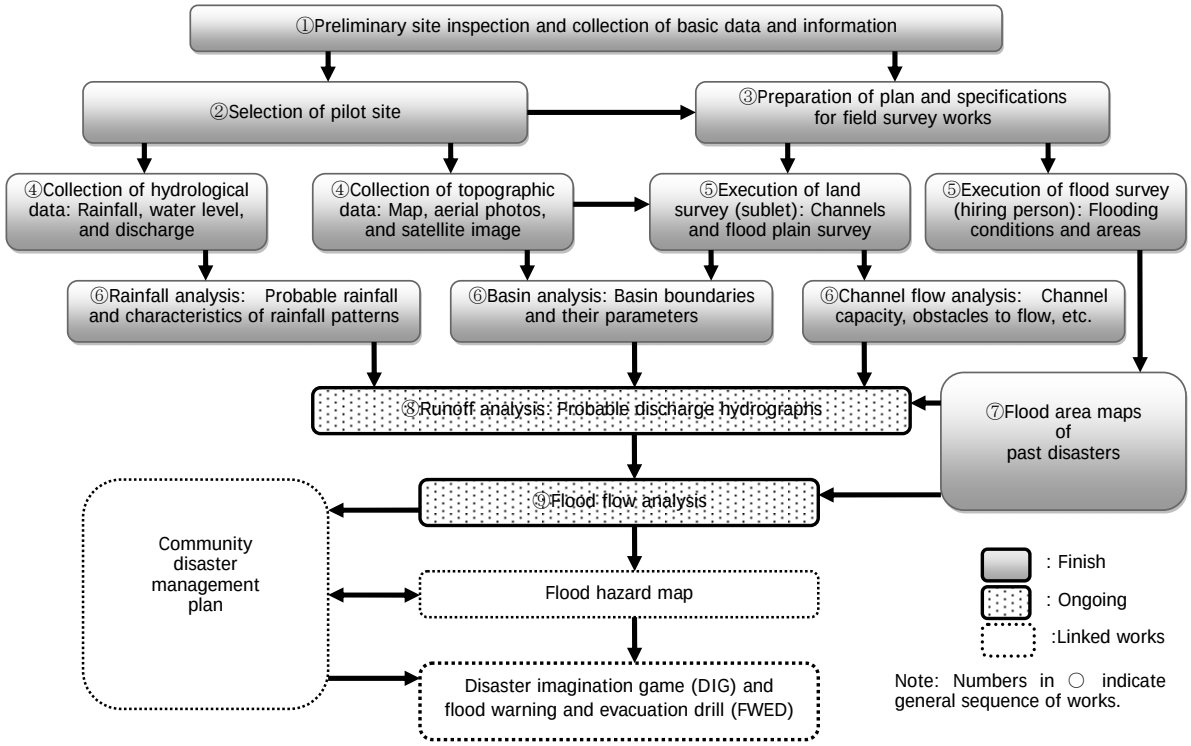


Fig. 3-1 Flow of Flood Analysis applied to the Project

Technical Meeting:
In order to exchange technical views CIMH Officials including Regional Team (RT) members on the topics of flood analysis, flood disaster prevention and other related matters, Technical Meetings were held periodically and on occasions. During the First Mission from February to May, 2009, the meetings were held four times seizing opportunity between intermittent country missions. During the Second Mission from October to December, 2009: The meetings were held nine times, more frequently than the first mission, because the flood analysis was carry out during the Second mission with RT members of CIMH in collaboration. Main topics of the meetings were as follows.

Table 3-6 Main Topics of Meeting related to Flood Analysis (First Year)

Date	Main topics
First Mission:	
26 Feb. 2009	Work flow of flood analysis and schedule of studies and field trips
20 Mar. 2009	Review of field trips (Guyana and Belize) and modeling of basins

Date	Main topics
09 Apr. 2009	Scopes and procedures necessary for field surveys (flood and land survey)
15 Apr. 2009	Specifications and contract documents for field surveys (5 river basins)
Second Mission:	
07 Oct. 2009	Review of progress and work schedule in this mission
15 Oct. 2009	Selection of runoff software, WMS or HEC-HMS
22 Oct. 2009	Review of flood surveys; Collection of supplementary topo/hydro. data
29 Oct. 2009	Review of flood surveys; Rainfall analyses of CIMH and Grenada
05 Nov. 2009	Additional rainfall analysis of CIMH; Basin analysis
19 Nov. 2009	Preparation of input data for runoff analysis; Sample flood flow calculations
26 Nov. 2009	Analyses of hydrological records of Belize and Mahaica rivers
03 Dec. 2009	Discussions on flood flow analysis; Flood analysis of the Great River
17 Dec. 2009	Flood analysis of the Roseau River; Schedule of future study works

3.2.2 Second Year

The second year activities related to the flood analysis were conducted from August to November 2010 and those were the supplementary flood survey and the flood analysis.

(1) Supplementary flood analysis

After implementing flood analyses in the first year and evaluating flood surveys and land surveys results, it was identified that some hydrological data and field data/information regarding past floods were necessary additionally for the flood analysis. These items identified were integrated as specifications for Supplementary Flood Analysis. Therefore, these data are mostly supplementary ones of those collected in the previous year and different from each other depending on the rivers.

Supplementary Flood Survey was carried out by local consultants under the sublet contract with the JICA team. Since the survey aims to supplement the flood survey carried out in the previous year, contractors were selected by direct appointment to the consultants who carried out the works in the previous year.

(2) Flood analysis

In the first year, approaching methods and tools for flood analysis were examined and tested with use of the data available in that stage. Then, the results of flood survey and land survey were in hand for respective pilot river basins. After reviewing these data, JICA Expert and RT in charge conducted the field trips in September and early October, 2010. In conjunction with the field trips, Supplementary Flood Survey in respective countries has started.

The full scale studies were made. Evaluations and arrangements of data for definitive runoff and channel flow analyses was carried out based on the survey results and supplementary field data.

(3) Field trips during activities

Field trips to the pilot states of the Project were conducted. Purposes of this mission are mainly to discuss with NT members and inspect sites (1) to collect additional field data and information for flood analysis, (2) to confirm the installation sites of rainfall and water level gauges for early flood warning, and (3) to promote sublet contracts procedures for Supplementary Flood Survey to be carried out by the local consultants.

The mission consists of JICA Expert (Flood Analysis) and relevant RT Members (CIMH), and visited the pilot states from September 1 to October 9, 2010 as follows:

Table 3-7 Field Trips for Flood Analysis (Second Year)

No.	Time of visit	Pilot state	Attending persons
1	1st. week of Sept.	Grenada	Mr. Jitsuhiro (JICA), Mr. Boyce (CIMH)
2	2nd. week of Sept.	Guyana	Mr. Jitsuhiro (JICA), Mr. Boyce (CIMH)
3	3rd. week of Sept.	Saint Lucia	Mr. Jitsuhiro (JICA), Miss. Pounder (CIMH)
4	3rd. week of Sept.	Dominica	Mr. Jitsuhiro (JICA), Miss. Pounder (CIMH)
5	2nd week of Oct.	Belize	Mr. Jitsuhiro (JICA), Miss. Pounder (CIMH)

Regarding the flood analysis, study results made so far were briefed in the respective pilot states visited, and discussed with NT members. During the site inspection, additional data and information were collected, covering basin's topography and geography, flood flow conditions, river channel and structures which interfere smooth flood flows, etc. Outputs of flood analyses were improved based on these data and information as well as Supplementary Flood Survey results.

3.2.3 Third Year

The third year activities related to the flood analysis was the country missions to the pilot states, with final results of the flood flow analysis based on the additional data and information in the second year.

(1) Objectives

Country mission was conducted for the following objectives:

- To explain and discuss on the results of flood study.
- To explain and discuss on the process of preparation of flood hazard map.
- To exchange views on the current topics regarding early flood warning.
- To inspect sites of pilot river basin and monitoring stations (rain gauge and water level gauge) installed or to be installed by the Project.

(2) Schedule

The country mission meetings were conducted with the following schedule:

- Dominica: on 22 Aug. 2011 (Mon), at Office of Disaster Management (ODM), Roseau City
- St. Lucia: on 24 Aug. 2011 (Wed), at National Emergency Management Organization (NEMO), Kastries
- Grenada: on 26 Aug. 2011 (Fri), at National Disaster Management Agency (NaDMA), St. George's
- Belize: on 02 Sep. 2011 (Fri), at the office of National Meteorological Services (NMS), Belize City
- Guyana: on 06 Sep. 2011 (Tue), at Civil Defense Commission (CDC), Georgetown

(3) Meeting

The meeting was held between NT and JT members on the following subjects and materials:

Handouts:
Two handouts were prepared for the NT-meetings, i.e., 1) Basic Studies for Flood Analysis, and 2) Flood Analysis for Relevant Pilot River Basin, which forms a part of Technical Notes for Flood Analysis.
Data-DVD:

In addition to the above handouts, two copies of data-DVD were handed over to each National Team for their use. The data-DVD includes all study results and supporting data.

1) Field survey results: Field survey results carried out by local consultants and surveyors under sublet contract with JICA expert team.
2) Studies: Related files of Technical Notes including power-point file, and work files
3) Data: Main data collected for the flood analysis study

3.3 Flood Hazard Map (FHM)

3.3.1 First Year

The activities of the first year related to the Flood Hazard Map are itemized to (1) preparation of draft FHM and (2) updating of Flood Hazard Mapping Manual.
Activities and achievement of the above items are summarized below:

(1) Preparation of FHM

Review of Map Parameters
Several map parameters such as map datum, ellipsoid and map projections are utilized in Caribbean regions. Specification of map parameters on the base map for flood hazard mapping is important for the effective use of flood simulation results and further flood analyses.
Map parameters applied to "Status of Hazard Maps Vulnerability Assessments and Digital Maps in the Caribbean" (Final Report, December 2003) are summarized below.

Table 3-8 Map Parameter used in Pilot States

Basin (Country)	Datum	Ellipsoid	Projection/Grid
Belize R. Valley (Belize)	North American Datum 27	Clarke 1866	Transverse Mercator
Roseau R. (Dominica)	Dominica 1945	Clarke 1880 modified	Transverse Mercator / British West Indies Grid
Great R. (Grenada)	Grenada 1953	Clarke 1880 modified	Transverse Mercator / British West Indies Grid
Mahaica R. (Guyana)	Prov. SA 1956	International 1924	Transverse Mercator
Bois d'Orange R. (St. Lucia)	St. Lucia 1955	Clarke 1880 modified	Transverse Mercator / British West Indies Grid

Above map parameters were applied to the preparation works FHM.

Preparation of Base maps for Flood Hazard Mapping
Available maps for flood hazard mapping were collected and compiled as GIS data. Base maps for flood hazard mapping of each pilot site and objective river basin were selected as follows;

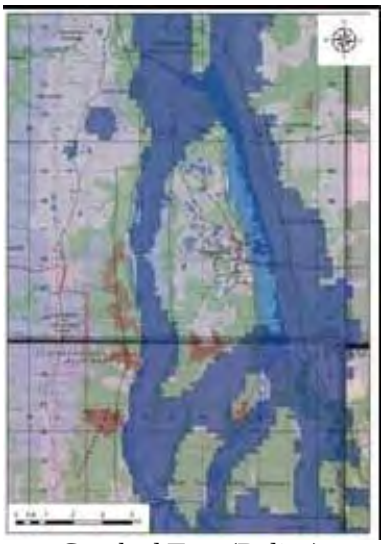
Table 3-9 Base Map for FHM

Country (Basin)	Pilot Site	FHM Base Map for 1st CBDRM activities	Other key maps
Belize (Belize R. Valley)	Crooked Tree	・1:50,000 topo map ・Google Earth	・Satellite Image (03-Dec-2008)
Dominica (Roseau R.)	Bath Estate	・Satellite Image (25-May-2008)	・1:25,000 topo map ・1:2,500 topo map ・Google Earth (18-Feb-2005)
Grenada (Great R.)	Balthazar Village	・Google Earth (03-Feb-2004)	・1:25,000 topo map ・Satellite Image (28-Nov-2005)
Guyana (Mahaica R.)	Grass Hook, Little Biaboo, Big Biaboo, Hansom Tree, Floral Garden	・1:50,000 topo map ・Google Earth (07-Oct-2002)	・Satellite Image (06-Sep-2008) ・

Country (Basin)	Pilot Site	FHM Base Map for 1st CBDRM activities	Other key maps
St. Lucia (Bois d'Orange R.)	Corinth	・Google Earth (07-Oct-2002)	・1:2,500 topo map ・Satellite Image (28-Nov-2005)

Preparation of Flood Hazard Map

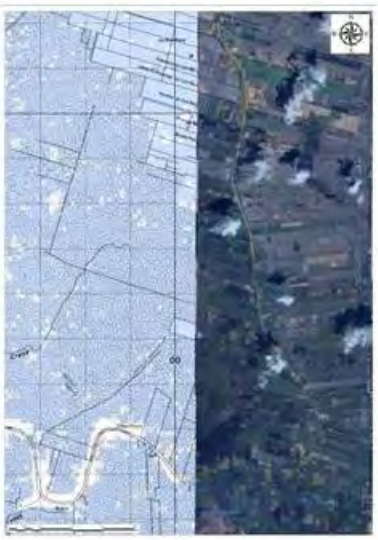
The probable flood area map of each pilot site is prepared as the first version of FHM. Prepared first version of FHM for each pilot site is as follows;



Crooked Tree (Belize)
w/ flood record (Satellite image)

Bath Estate (Dominica)
w/ flood analysis (2007 flood)

Balthazar Village (Grenada)
w/ flood survey (2000 flood)



Grass Hook, Little Biaboo, Big Biaboo,
Hansom Tree, Floral Garden (Guyana)
w/ DEM (< 3m)

Corinth (St. Lucia)
w/ flood analysis (2008 flood)

Fig. 3-2 First Version of Flood Hazard Map (First Year)

Flood Hazard Map are prepared for each pilot site in consideration of further study results such as flood analysis, evacuation route, community activities and so on. Base maps for FHM of each pilot site were prepared as GIS data.

(2) Updating of Flood Hazard Mapping Manual

In the Phase 1 of the CADM Project, "Manual for the Production of Flood Hazard Maps in the Caribbean" was prepared by the CADM (Phase-1) RT. This manual is revised and updated based on the experience of preparation of FHMs at 5 pilot sites incorporating lessons and experiences of ongoing activities in this Project

During the first year period, "ANNEX: TECHNICAL APPROACH" was prepared. This Annex contains a practical use of application software for GIS and flood analysis, such as ArcGIS, HEC-HMS, HEC-GeoHMS, HEC-RAS and HEC-GeoRAS.

3.3.2 Second Year

(1) Revision of FHM

The probable flood area in FHM was revised as the following methods, in consideration of the present flood condition and availability of data for the flood analysis of the each pilot site:

- Continental basin (Belize and Guyana): Based on the experienced flood
- Island basins (for Dominica, Grenada and Saint Lucia): Based on the flood analysis.

Belize:
The probable flood area in FHM was revised based on the actual experience of the community people through the supplementary flood survey. Five teams of local community residents were mobilized to collect the data on inundation depth in the past flood. More than 950 points data were collected and the longitude and latitude of each point was measured by the handy GPS.
All collected data were compiled as GIS data and verified by using GIS software. Additional supplemental data based on the observed field condition were also directly added to the GIS.

Finally, the second draft of FHM in Crooked Tree was developed by using GIS software functions.
Results of activity on flood hazard mapping and the first draft of FHM are also reported to NEMO during the second year period.

Guyana:
The probable flood area in FHM was revised based on the actual experience of the community people through the supplementary flood survey.
Three teams of local community residents were mobilized to collect the data on inundation depth in the past flood. More than 300 points data were collected and the longitude and latitude of each point was measured by the handy GPS.
All collected data were compiled as GIS data and verified by using GIS software. Finally, the second draft of FHM in Little Biaboo, Big Biaboo and Grass Hook was developed.
Results of activity on flood hazard mapping and the second draft of FHM are also reported to CDC during the second year period.

Dominica:
Model preparation was made in the first year activities and the first draft was prepared for 2007 year flood, but due to the delay of the land survey and flood survey in the first year, the calibration of the model was shifted to the second year activities. The draft was prepared and the results were shared among RT members and JICA team member.

Grenada:
Model preparation was made in first year activities and the first draft was prepared for 2000 year flood. But, due to the delay of the land survey and flood survey in first year, the calibration of the model was shifted to the second year activities. The draft was prepared and the results were shared among RT members and JICA team member.

St. Lucia:
Model preparation was made in first year activities and the first draft was prepared for 2008 year flood. But due to the delay of the land survey and flood survey in first year, the calibration of the model was shifted to the second year activities. The draft was prepared and the results were shared among RT members and JICA team member.

(2) Updating of Flood Hazard Mapping Manual

Updating of flood hazard mapping manual was conducted as preparation of an additional part for the case to prepare the flood hazard map based on the past experience of community people when the hydrological analysis could not be made, that is, Incidental Map. The additional part was prepared as an independent attachment of the previous manual, and was submitted to CDEMA for further discussion.

3.3.3 Third Year

The third year activity related to the FHM is itemized as follows:

- Country mission on flood analysis and flood hazard map during a period from August to September 2011 (described in sub-section of 3.2.3)
- Revision of FHM of each pilot site
- Updating of Flood Hazard Mapping Manual

The final FHMs, as the output of CADM 2 activities, are finalized through discussions with NT and community. Consequently, following major subjects are mainly pointed out during the discussions with NT and community in each pilot state;

Belize:
- Flood hazard is categorized into three hazard levels: Low Hazard, Medium Hazard and High Hazard. Each level is color-corded.
- Individual houses of "Family to Relocate" and "Safe shelter" and evacuation routes should be clearly shown in FHM.

Dominica:
- Only flood area boundaries (without depth information) are shown in FHM.
- Evacuation routes to two temporary shelters should be shown in different colors.
- The location of steps should be clearly shown in FHM as an alternate route for evacuation.
- "Note" for the explanation of FHM should be added in FHM for easy understanding.

Grenada:
- Only flood area boundaries (without depth information) are shown in FHM.
- Flood from river and flood from canals/gullies should be clarified in FHM.
- Detailed information of "Safe Houses", i.e. geographic location and the picture of residence, should be compiled as GIS data.
- "Note" for the explanation of FHM should be added in FHM for easy understanding.

Guyana:
- Flood hazard is categorized into three hazard levels: Low Hazard, Medium Hazard and High Hazard. Each level is color-corded.
- Detailed information of "Family to Evacuate", i.e. geographic location and the picture of residence, should be compiled as GIS data.
- "Note" for the explanation of FHM should be added in FHM for easy understanding.

St. Lucia:
- Only flood area boundaries (without depth information) are shown in FHM.
- Evacuation method of "People Relocating to Safe Shelter" and "People Relocating Upstairs" should be clearly differentiated (by use of symbols) in FHM.

(1) Revision of FHM

The revision of the FHM of each pilot site was conducted through the following process:

1) Revision of the draft FHM in consideration of community use by the JICA expert and the members of RT.
2) Finalization of the FHM by the members of NT and RT and the JICA expert during the country mission.

The country missions to the pilot states were conducted by the experts for FHM and for CBDRM and members of RT. The results of the each country mission are summarized hereunder:

Dominica
Period: from April 16 to April 22, 2012
Activities and Achievement:
- Discussion with the members of NT.
- Finalization of FHM, with the members of the following agencies:
  - Physical Planning Division (Ministry of Environment, Natural Resources, Physical Planning and Fisheries)
  - Lands and Surveys Division (Ministry of Housing, Lands, Settlement and Water Resources Management)

- Technical Services Division (Ministry of Public Works)

- Billboard of the final FHM was installed at the pilot site before the evacuation drill.
- A set of data including the final FHM was handed over to the Physical Planning Division in order to maintain and improve the FHM.

Finalization of FHM (Dominica)

Billboard of FHM in the Pilot site (Dominica)

Grenada:
Period: from April 29 to May 6, 2012
Activities and achievements:

- Discussion with the members of NT.
- Finalization of FHM, with the members of Physical Planning Unit (Ministry of Works, Physical Development and Public Utilities)
- Billboards of the final FHM were installed at the pilot site before the evacuation drill of the community.
- A set of data including the final FHM was handed over to the Physical Planning Unit in order to maintain and improve the FHM.

Billboard of FHM in the Pilot site (Grenada)

Billboard of FHM in the Pilot site (Grenada)

Guyana
Period: from May 6 to May 13, 2012
Activities and achievement

- Discussion with the members of NT.
- Finalization of FHM, with the members of the following agencies:
  - Guyana Land and Survey Commission (GL&SC), Ministry of Agriculture
  - Guyana Forestry Commission (GFC), Ministry of Agriculture
  - Guyana Geology and Mines Commission (GGMC), Ministry of Natural Resources and

the Environment
- University of Guyana (UG)
- Guyana Red Cross

- Billboards of the final FHM were installed at the pilot site before the evacuation drill of the community.
- A set of data including the final FHM was handed over to the Civil Defense Commission in order to maintain and improve the FHM.

Billboard of FHM in the Pilot site (Guyana)

Billboard of FHM in the Pilot site (Guyana)

Belize
Period: from May 14 to May 19, 2012
Activities and achievements:

- Discussion with the members of NT.
- Finalization of FHM, with the members of the Land Information Centre (LIC), Land and Surveys Department Ministry of Natural Resources and the Environment.
- Preparation of the Flood Warning Map based on the warning level of the FEWS, with the members of the LIC.
- A set of data including the final FHM was handed over to the LIC in order to maintain and improve the FHM.

Activities in LIC (Belize)

Sample of Flood Warning Map
(7.0 m Flood Warning: Belize)

Saint Lucia
Period: from May 20 to May 25, 2012
Activities and achievements:

- Discussion with the members of NT.
- Finalization of FHM, with the members of the Physical Planning Section (Ministry of Physical Development and the Environment).
- A set of data including the final FHM was handed over to the Physical Planning Section in order to maintain and improve the FHM.

The final FHMs of the respective pilot states are presented in Fig. 3-3.

(2) Updating of Flood Hazard Mapping Manual

Updating works of the Flood Hazard Mapping Manual during the first and second year period were carried out as the amendments of the original manual in the Phase 1.

The meeting on the manuals including that for establishing flood early warning system and that for community disaster management planning was held on August 30, 2011 in Barbados. During this meeting, several comments on the manuals were raised. The basic points of the comments on the Flood Hazard Mapping Manual were as follows:

The basic structure of the manual should be as follows: Section 1: Background 1.1 Flooding in the Caribbean 1.2 CADM 2 1.3 Purpose of the Manual 1.4 Target Audience Section 2: Flood Hazard 2.1 Types of Flood 2.2 Flood Analysis Section 3: Flood Hazard Mapping 3.1 Basic Definitions 3.2 Flood Hazard Mapping Methods 3.3 Uses of Flood Maps

In response to the above comments, the updated manual was restructured, collaborating with the JICA expert and the members of RT.

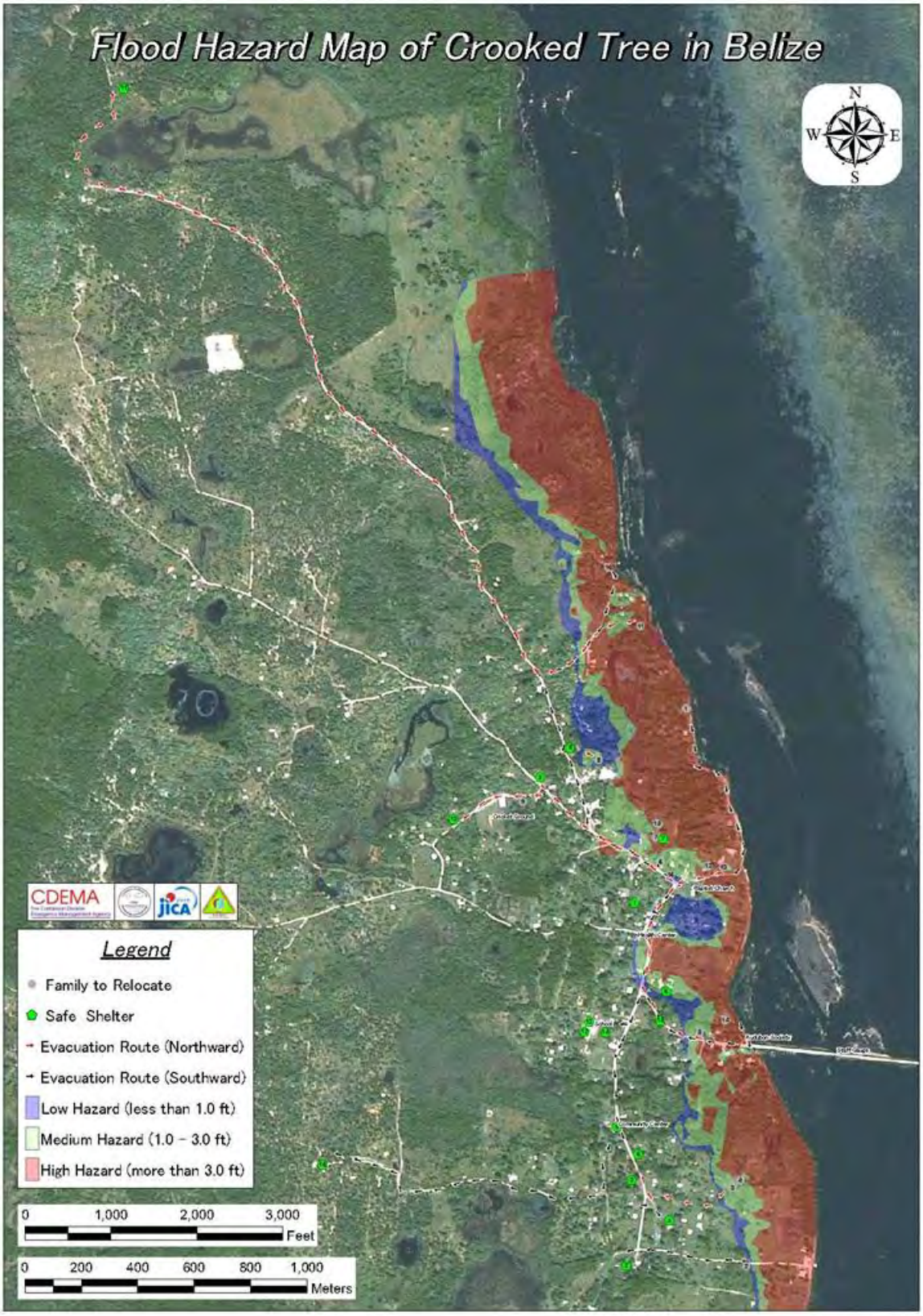


Fig. 3-3 Final Flood Hazard Map: Crooked Tree in Belize (1/5)

Fig. 3-3 Final Flood Hazard Map: Bath Estate in Dominica (2/5)

Fig. 3-3 Final Flood Hazard Map: Balthazar Village in Grenada (3/5)

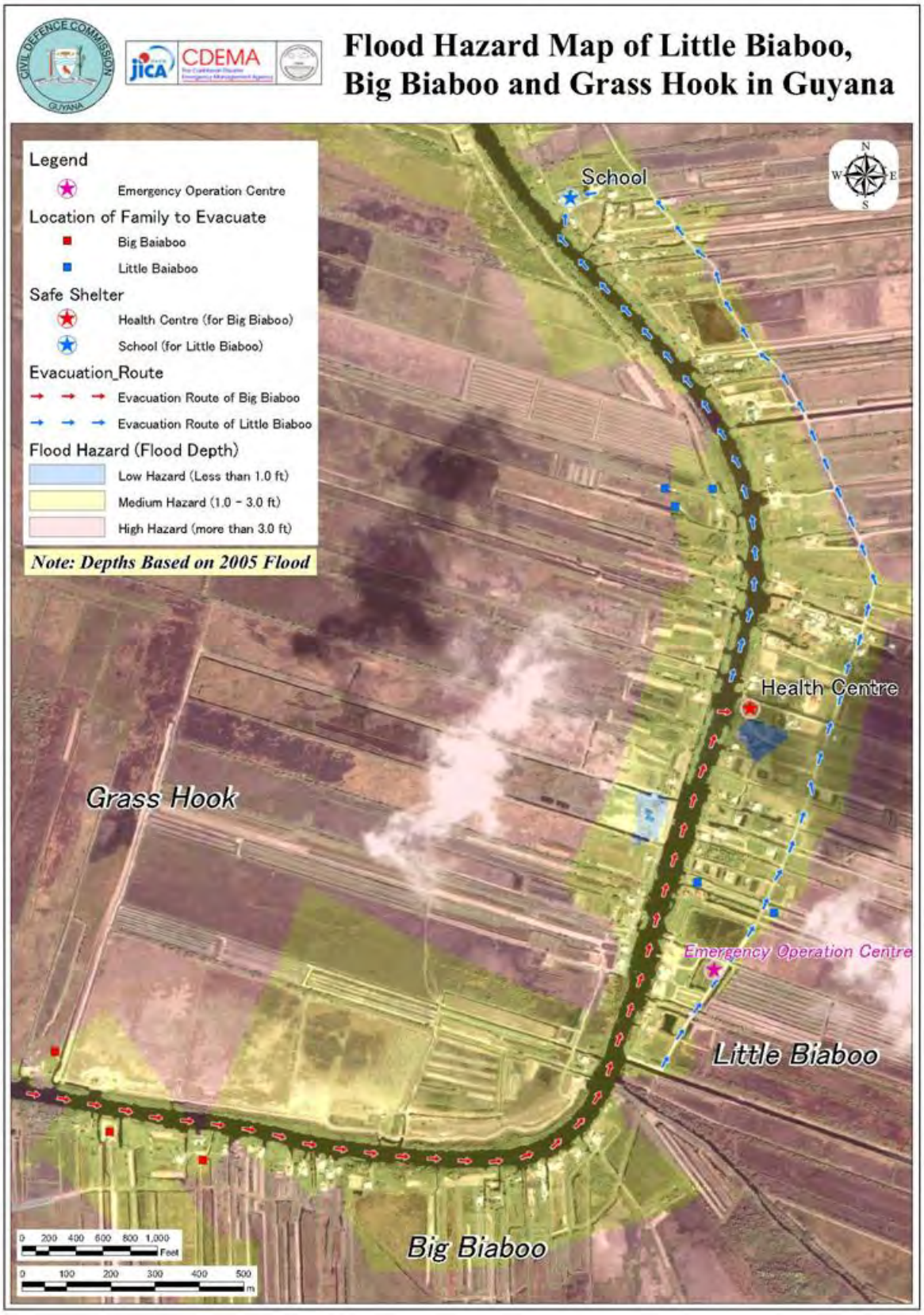


Fig. 3-3 Final Flood Hazard Map: Upper Mahaica Communities in Guyana (4/5)

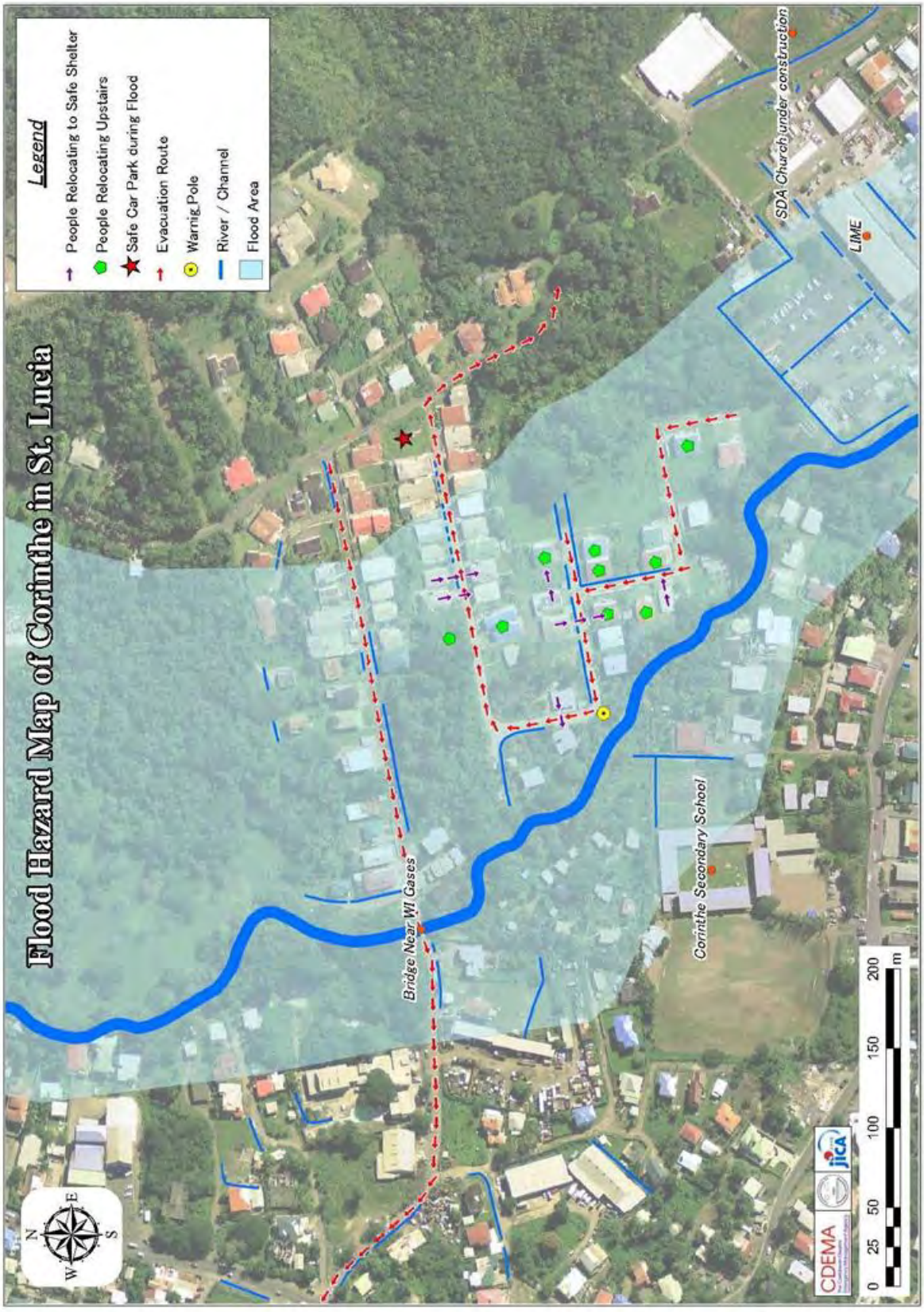


Fig. 3-3 Final Flood Hazard Map: Corinth in Saint Lucia (5/5)

3.4 Flood Early Warning System (FEWS)

The basic structure of flood early warning system is that hydrological situation in the upstream basin of the target community is to be detected by hydrological gauges and the information is to be transmitted to the related agencies such as national disaster organization and the committee of the community and necessary actions are to be conducted for the safety of the people and the properties.

Accordingly the locations of the hydrological gauges and the specifications of the gauges are studied.

Location of the hydrological gauges of each pilot basin is presented in Fig. 3-4 and list of hydrological gauges including installation records are shown in Table 3-10, respectively.

3.4.1 First Year

(1) Installation of Hydrological Gauges

Based on the hydrological analysis, numbers and the locations of hydrological gauges to be installed for establishing the early flood warning system in each pilot state were concluded. But because it took time for finalization of specifications of those hydrological gauges, the installation itself was carried over to the Year 2 activities.

The first proposal on the specifications of rainfall gauge was that rainfall gauge was without data logger and the method to detect rainfall amount was to store the rainfall in a bucket and the sensor in a bucket will detect the rainfall amount.

But this type of rainfall gauge was rejected by one of NTs since it is very difficult when the stored rainwater should be drained from the bucket.

The rainfall gauge specifications were finalized in the first JCC Meeting held at the end of the First Year and accordingly the installation of gauges could not be implemented in the First Year. The agreed specifications of the rainfall gauge were that rainfall amount is to be detected by installed program while rainfall amount is to be recorded with a tipping bucket type with a capacity of 0.5 mm. The water-level gauge specifications were also of the type with data logger and program method to detect the water-level.

With these specifications, the warning levels of water-level and rainfall amount for flood early warning system could be updated based on the hydrological analysis on the recorded rainfall and water-level.

(2) Basic Concept of Flood Early Warning System

The basic point of early flood warning system is that the estimate of flood at the community should be prepared based on the correlation between rainfall and river water-level in the upstream basin and the water-level at the target community site.

The information about the flood for the community should be prepared in a very short time and with an easy method since the general situation of related agencies during flood is usually very abuzz and if the flood information should be obtained through some calculation or simulation, the calculation may lead to wrong results due to operational error of data input. Besides, the electricity of the agency during flood may not be available due to electrical power failure.

Accordingly the estimate of flood at the target community should be prepared by use of a graphic

based on the correlation. The graphics should be prepared as the results of hydrological analysis based on the obtained hydrological data in the past.

Presently the relationship is obtained as follows:

Crooked Tree in Belize
Based on the daily water-level data, the correlation between the water-level at Banana Bank of the Belize River and the water-level at Crooked Tree is obtained. Basically this relationship is to be utilized for flood early warning system. The detailed is shown in Attachment-4.

Bath Estate in Dominica
Water-level correlation between the water-level at Bath Estate and the water-level at the Palm Gove is obtained through the hydraulic analysis. Accordingly the warning levels are prepared based on the water-level at Palm Grove.

Lower Balthazar in Grenada
Water-level correlation between the water-level at Lower Balthazar and the water-level at the Castaign Bridge is obtained through the hydraulic analysis. Accordingly the warning levels are prepared based on the water-level at Castaign Bridge.

Little Biaboo and Big Biaboo in Guyana
Water-level correlation between the water-level at Little Biaboo and Big Biaboo and the water-level at the St. Cuthberts is to be analyzed. Since the installation of the gauges in Guyana was rather delayed, this relationship is to be obtained after the hurricane season of this year. Accordingly the warning levels are set based on the request of the community of Little and Big Biaboo, that the water-level at the community of the Mahaica River is presently utilized.

Corinth in Saint Lucia
Water-level correlation between the water-level at Corinth and the water-level at the Upper Corinth Bridge is obtained through the hydraulic analysis. Accordingly the warning levels are prepared based on the water-level at Upper Corinth Bridge.

3.4.2 Second Year

(1) Installation of Hydrological Gauges

Due to the limited budget and time for related personnel for Year 2 activities, the gauges were divided into 2 lots for installation in Year 2 and in Year 3.

In the Year 2, 1st lot of the gauges was planned to be purchased and installed. And in the Year 3, the 2nd lot gauges as remaining gauges was planned to be purchased and installed...

The number and the locations of 1st lot of gauges were decided in consideration of the minimum requirement for early flood warning and the limited budget.
For the installation of those gauges, the following works were conducted:

- Articulation of works among RT, NT and JICA Expert Team
- Selection of pinpointed installation sites
- Confirmation of sites for finalization of specifications of gauges
- Finalization of specifications of gauges
- Finalization of installation schedule
- Procurement arrangements

In Year 2, the purchase of gauges was conducted and ordered gauges arrived at the designated shipping addresses but the installation of gauges was not conducted yet as of the end of February 2011. But after all the JICA Expert Team left the Caribbean Region in March, the installation of gauges in Dominica and Belize was conducted with the effort of CIMH and NTs.

(2) Establishment of FEWS

Since the hydrological gauges for establishment of early flood warning system were not installed yet at the sites, establishment of early flood warning system was not completed yet.

The basic features of technical part of the system have been established in Year 1 activities and the procedural part of the system was planned to be finalized with necessary discussion with NT of each pilot state in Year 3.

(3) Preparation of Early Flood Warning System Establishment Manual

Early flood warning system establishment manual was prepared separately and was submitted to CDEMA for further discussion.

(4) Seminar for Establishment of Early Flood Warning System

Seminar for establishment of early flood warning system was conducted based on the manual on March 15, 2011 in Barbados in the annual seminar.

3.4.3 Third Year

(1) Installation of Hydrological Gauges

In Year 3, an additional JICA expert was assigned in order to accelerate installation activities of the hydrological gauges. During Year 3, the following activities were conducted for installation of the gauges:

- Procurement of 2nd lot of the gauges.
- Procurement of additional rainfall gauge for Belize in consideration of capacity enhancement of NT, since rain gauge was not planned to be installed in the pilot river basin in Belize.
- Installation and setting of the remaining gauges
- Additional land survey around Crooked Tree in Belize, in order to grasp the existing elevation of probable flood area.
- Leveling survey of the water level gauge datum elevation
- Guidance of operation and maintenance of gauges, especially data downloading from gauge loggers.
- Clarification on roles of the agencies related to the activities of FEWS in each pilot state.

Despite great efforts by the members of NT and RT, installation of the remaining gauges was delayed, due to delay of delivery of procured equipment and flood season in the pilot states. Installation of the remaining gauges was completed in April 2012.

(2) Seminar on Hydrological Gauges

Seminar on installation, operation and maintenance of hydrological gages was held on June 04, 2012, in Barbados by CIMH. The agenda of the seminar was as follows:

Time	Activity	Resource Agency/Person
08:30-08:35 08:35-08:45	Welcome Opening Remarks	Chair Ms. Elizabeth Riley, CDEMA, JICA
08:45-09:00 09:00 – 09:40	Group Introductions Campbell Scientific software and installation and setup.	All Participants CIMH
09:40 – 10:00	Discussion	All participants
10:00 – 10:10 10:10 – 10:50	Break Raven modem software, setup, installation and troubleshooting.	 CIMH
10:50 – 11:10 11:00 – 11:10	Discussion Break	All participants
11:10 – 11:50	Hardware discussion and display	CIMH
11:50 – 12:10 12:10 – 13:40	Outstanding installation issues Lunch	All participants

As shown in the above, CIMH gave the lectures on all the aspects of hydrological gauges in installation, maintenance, and data downloading. All the participants fully discussed about all the aspects and understood. Thus the seminar was held as one of the activities to guarantee the sustainability of the project.

(3) Establishment of FEWS

The FEWS of each pilot state was established through two times of the country mission by the JICA expert and members of NT through discussion with members of NT and objective community. Schedule of the county missions and those objectives are summarized as follows:

- First Country Mission
  Objective:
  - To confirm the basic concept of flood warning level
  - To discuss on flood warning levels
  - To discuss the flood warning communication flow

  Schedule:
  - Guyana: September 27, 2011
  - Dominica: October 7, 2011
  - Saint Lucia: October 11, 2011
  - Grenada: October 13, 2011
  - Belize: November 21, 2011

- Second Country Mission
  Objective:
  - To explain and discuss of FEWS including flood warning levels

  Schedule:
  - Dominica: April 16 and 18, 2012
  - Grenada: May 03, 2012
  - Guyana: May 07, 2012
  - Belize: May 15 and 16, 2012
  - Saint Lucia: May 23, 2012

Established FEWS system of each pilot site is explained in Attachment – 4 of this Report.

(4) Updating of Flood Early Warning Manual

Draft flood early warning manual once submitted to RT members in Year 2 activities and was discussed with the attendance of RT members and JT members in the mid-term meeting held in Barbados on August 30, 2011. In the meeting, a comment that the manual should be a one of user friendly and each established flood early warning system should be incorporated in the manual.
The draft manual was updated based on the comments and explained to the members of NT during the second country mission.

(5) Locations of Hydrological Gauges

The final locations of hydrological gauges are shown in Table 3-10 and in Fig. 3-4.

The followings are the explanations on the selection of the locations:
Belize
Sta. Familia (water-level):
The upstream of this site consists of two tributaries of the Macal River and the Mopan River. And the upstream of this site is mainly in the territory of Guatemala. Besides there exist big reservoirs in the upstream area. Accordingly this site is deemed to be the best place to catch the flood situation of the upstream basin of Belize River.
Banana Bank (water-level):
The site is located in the middle stream of the Belize River and some big tributaries join the Belize River
Big Fall (water-level):
Floods of the Belize River overflow to the left side bank and reach the Crooked Tree that is the target community of the flood early warning system.
Isabella Bank (water-level):
The characteristics of this location are the same with those of Big Fall.
Isabella Bank (rainfall):
There is no other rainfall gauge in this area.

Dominica
Laudat (rainfall):
This site is a representative site for the rainfall in the upstream basin of the Roseau River.
Morne Prosper (rainfall):
This site is a representative site for the rainfall in the middle stream basin of the Roseau River.
Palm Grove (water-level)
This site is a site just downstream side of the confluence of the Claire River that is the major tributary of the Roseau River.

Grenada
Morne Longue (rainfall)
This site is a representative site for the rainfall in one of the big tributaries of the Great River.
Grand Etang (rainfall):
This site is a representative site for the rainfall in another big tributary of the Great River.
Castaign Bridge (water-level)
This site is the confluence of the above two major tributaries of the Great River.
Guyana
St. Cuthbert Mission (rainfall and water-level)
This site is a representative site for rainfall and water-level for the upstream basin of the

Mahaica River.

Maduni Gate (water-level)

This site is one of the gate sites to release the water of the East Demerara Water Conservancy to the Mahaica River.

Big and Little Biaboo (water-level)

This site is located just in the target community area.

Saint Lucia

Plateau (rainfall)

This site is representative for the rainfall in the upstream basin of the Bois D'Orange River.

Grand Riviere (water-level)

This is the representative site for the river water-level of the Bois D'Orange River.

Upper Corinth (water-level)

This site is located just upstream of the target community of Corinth.

Table 3-10 List of Installed Hydrological Gauges

Nation	River	kind of Obs.	Sta. Name	Purchase Lot		Status		Type of Sensor	Remarks
				Sensor	Others	Purchase	Installation		
Belize	Belize R.	WL	Isabella Bank	2	2	already	already (April, 2012)	Pressure Type	Under operation.
		WL	Big Falls	1	1	already	already (April, 2011)	Pressure Type	Under operation.
		WL	Banana Banks	1	1	already	already (April, 2011)	Pressure Type	Under operation.
		WL	Sta. Familia	2	2	already	already (April, 2012)	Pressure Type	Under operation.
		R (additional)	Sta. Familia	add	add	already	already (April, 2012)	Tipping bucket Type	Under operation. (Location was changed from the plan.)
	* Additional rain gauge was installed in response to request from NT. * Remaining gauges were installed on 01-05/Apr/2012, including changing the SIM cards for the modem of gauges. * Land and leveling surveys are on going.								
Dominica	Roseau R.	WL	Palm Grove	1	1	already	already (April, 2011)	Ultrasonic Type	Under operation.
		R	Morne Prosper	1	1	already	already (April, 2011)	Tipping bucket Type	Under operation.
		R	Laudat	1	1	already	already (April, 2011)	Tipping bucket Type	Under operation.
	* Transmission problem of gauge at Laudat was discussed with Digicel (08/Mar). Transmission will be improved in future. * Guidance of data downloading and changing to the post-paid SIM card was finished. (07-09/Mar) * Leveling survey of the WL gauge datum elevation was finished. (09/Mar: JT received theresults.)								
Grenada	Great R.	WL	Castaign Br.	1	1	already	Already (04-07/Jul/2011)	Ultra Sonic Type	Under operation. Modification works was done on 11-13/Apr.
		R	Morne Longue	1	1	already	Already (04-07/Jul/2011)	Tipping bucket Type	Under operation. Modification works was done on 11-13/Apr.
		R	Grand Etang	1	1	already	Already (04-07/Jul/2011)	Tipping bucket Type	Under operation. Modification works was done on 11-13/Apr.
	* Modification works of the gauge installation and guidance of datadownloading were finished (19/Feb-23/Feb).								
Guyana	Mahaica R.	WL	Biaboo	2	2	already	Already (Apr/2012)	Pressure Type	Under operation.
		WL	St.Cuthberts	1	2	already	Already (Apr/2012)	Pressure Type	The site is outside of cellular network. Wi Fi system was applied.
		R	St.Cuthberts	1	2	already	Already (Apr/2012)	Tipping bucket Type	ditto
		WL	Maduni Gate	1	2	already	Already (Apr/2012)	Pressure Type	Under operation. No Cellular network. Recording only. Equipment was installed by Hydro-Met
	* Installation of the gauges were done by NT (Hydro-Met). RT (CIMH) checked setting of gauges with NT.								
St. Lucia	Bois d'Orange R.	WL	Corinthe	1	1	already	alreasy (14-18/Jun/2011)	Ultrasonic Tyoe	Under operation.
		WL	Grand Riviere	1	1	already	alreasy (14-18/Jun/2011)	Ultrasonic Tyoe	Under operation.
		R	Plateau	1	1	already	alreasy (14-18/Jun/2011)	Tipping bucket Type	Under operation.
	* Guidance of datadownloading and Changing to the post paid SIM card were finished. (29/Feb-02/Mar) * Leveling survey of gauge datum elevations was finished. (JT received the results on 15/Mar.)								
Total		WL	11						
		R	7 (including additional rain gauge in Belize.)						

Note, Location of hydrological gauges is presented in Fig. 3-1.

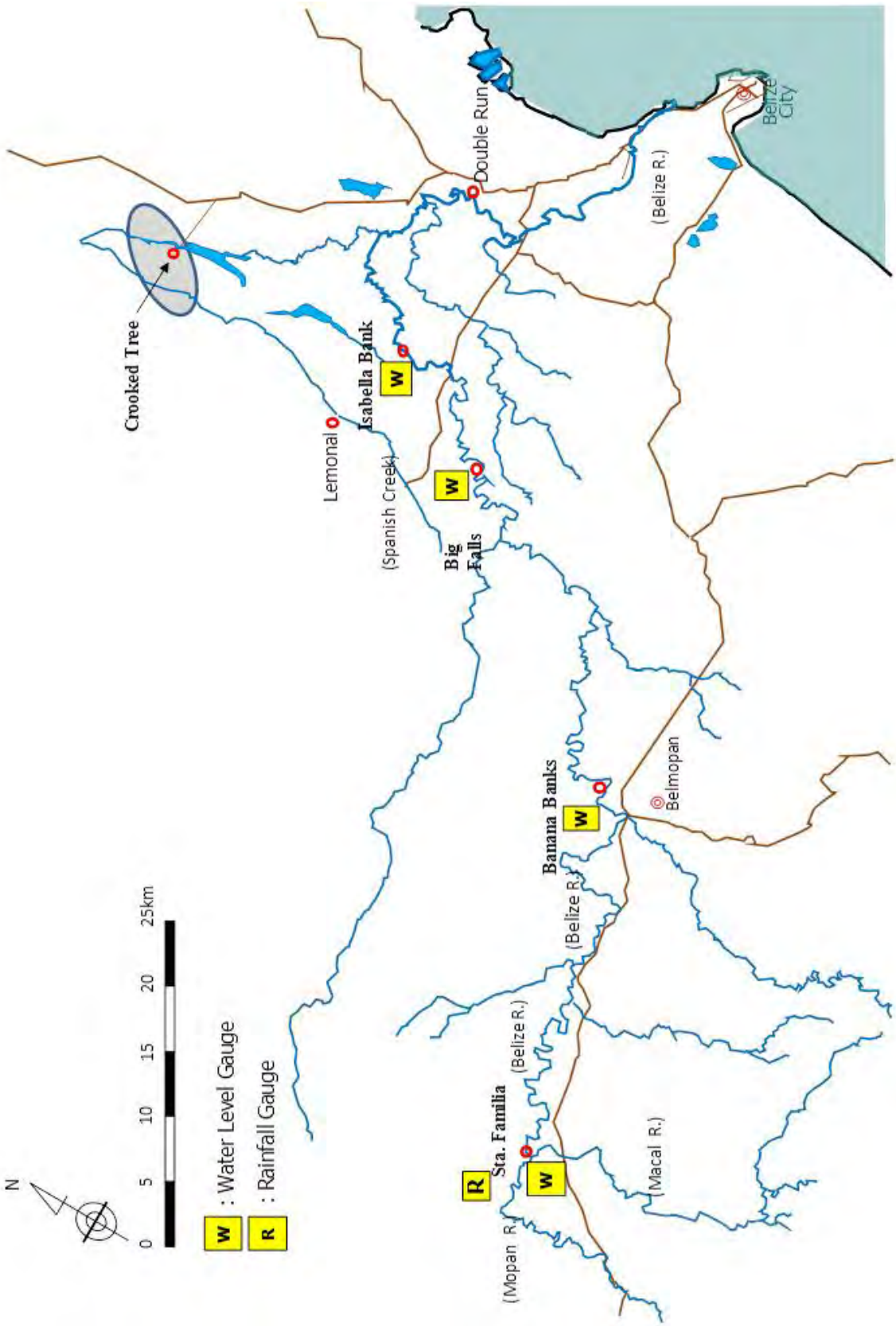


Fig. 3-4 Location Map of Pilot Site (1/5):
Crooked Tree Village, Belize River Basin, Belize

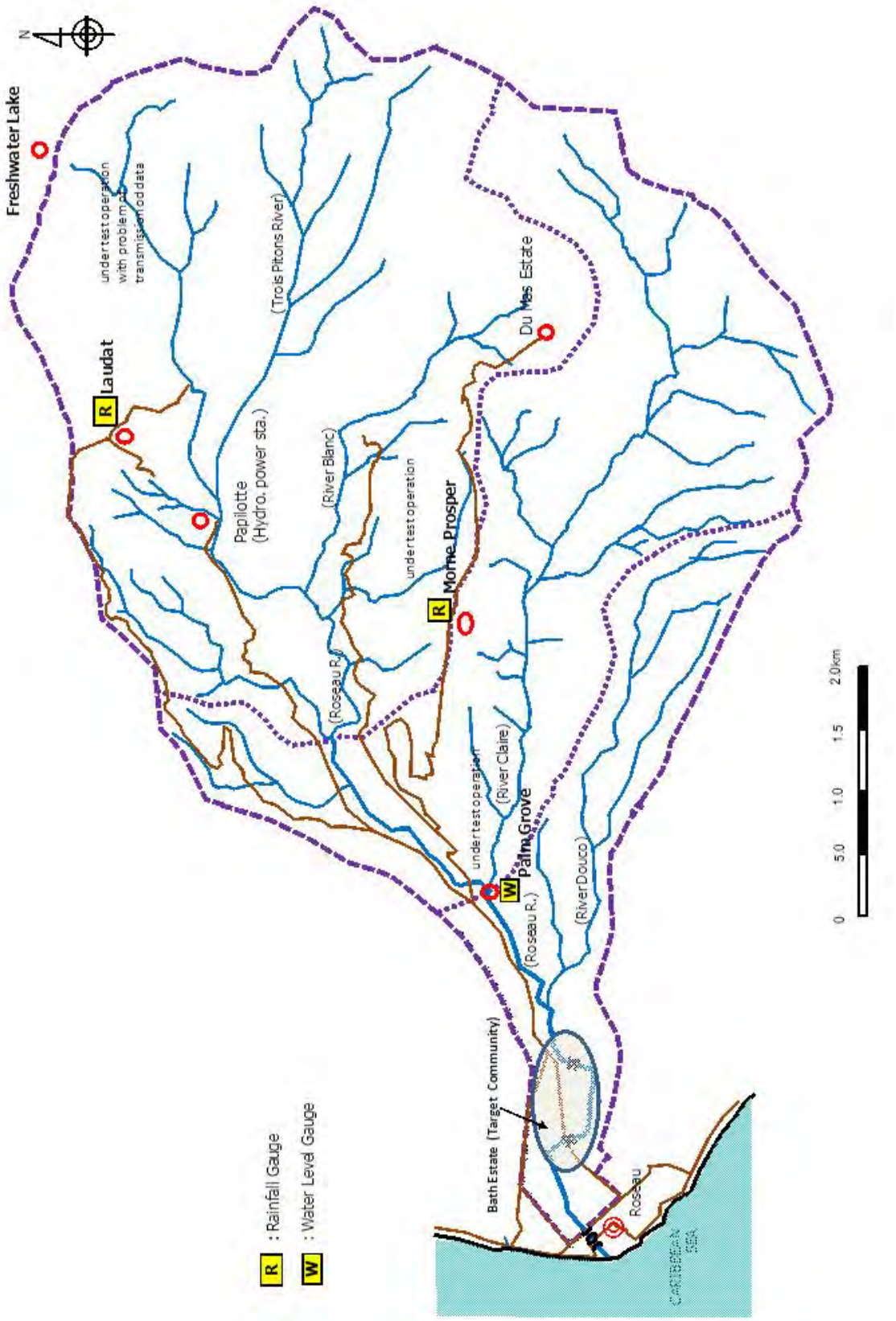


Fig. 3-4 Location Map of Pilot Site (2/5):
Bath Estate, Roseau River Basin, Dominica

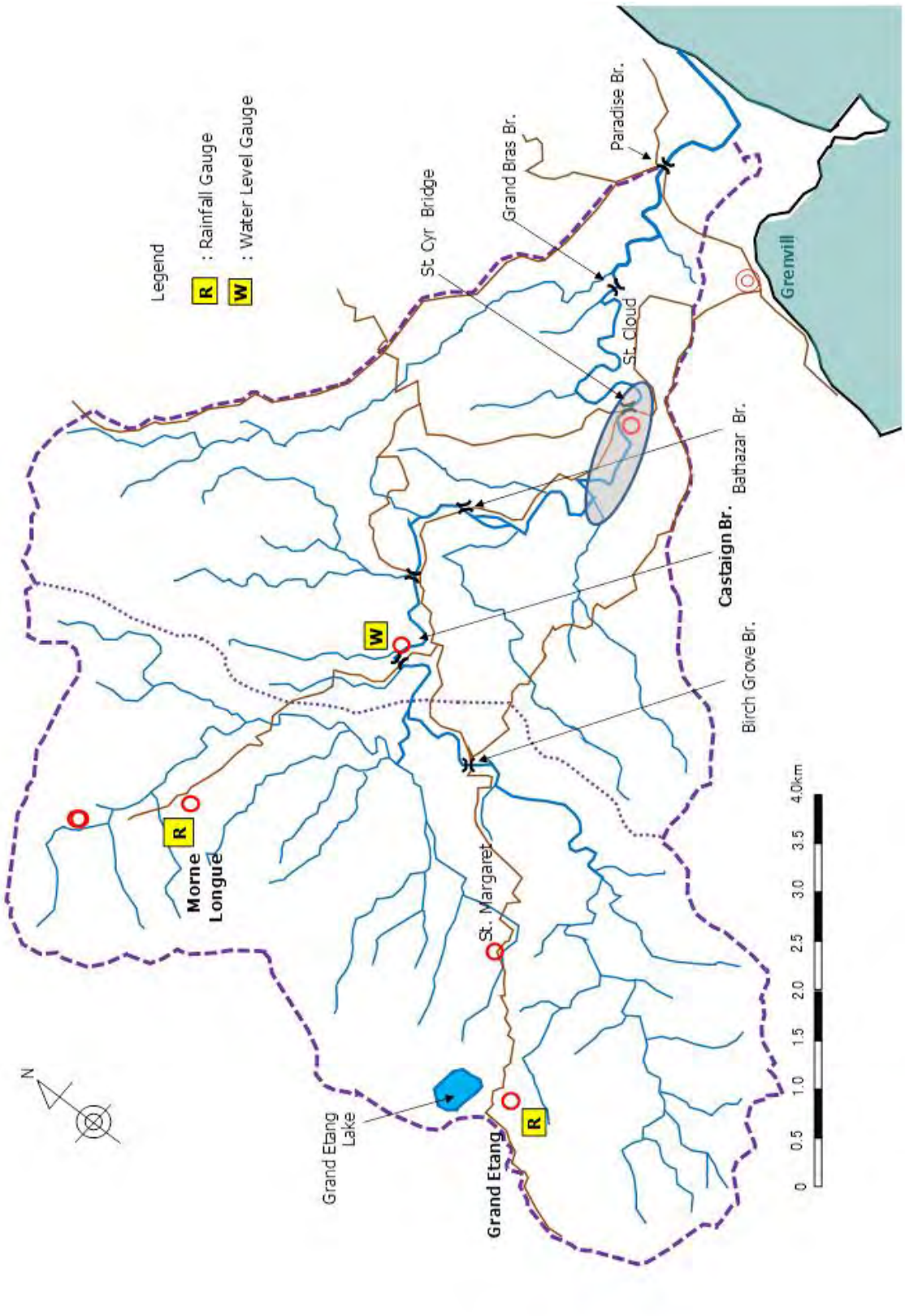


Fig. 3-4 Location Map of Pilot Site (3/5):
Balthazar Village, Great River Basin, Grenada

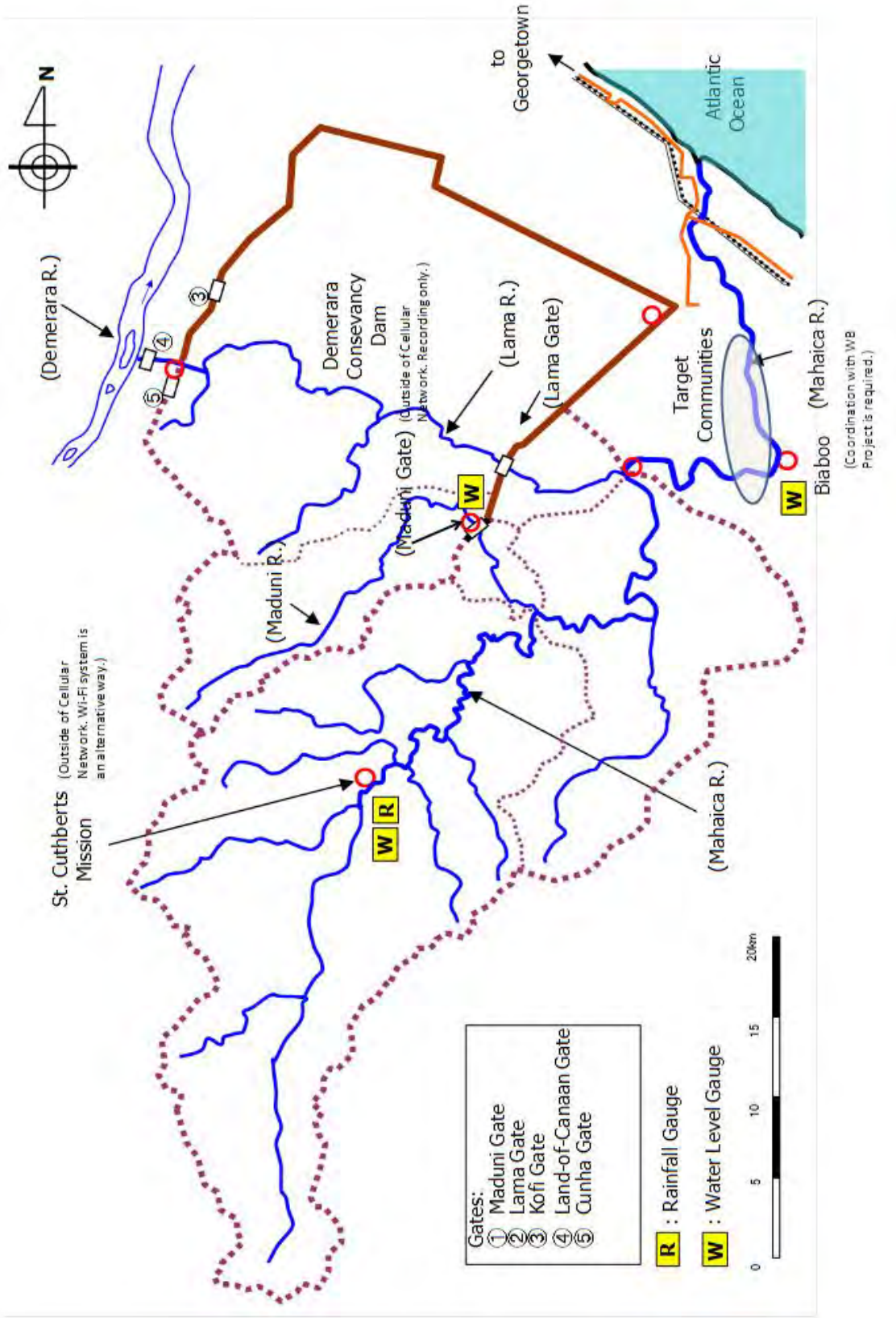


Fig. 3-4 Location Map of Pilot Site (4/5):
Upper Mahaica Communities, Mahaica River Basin, Guyana

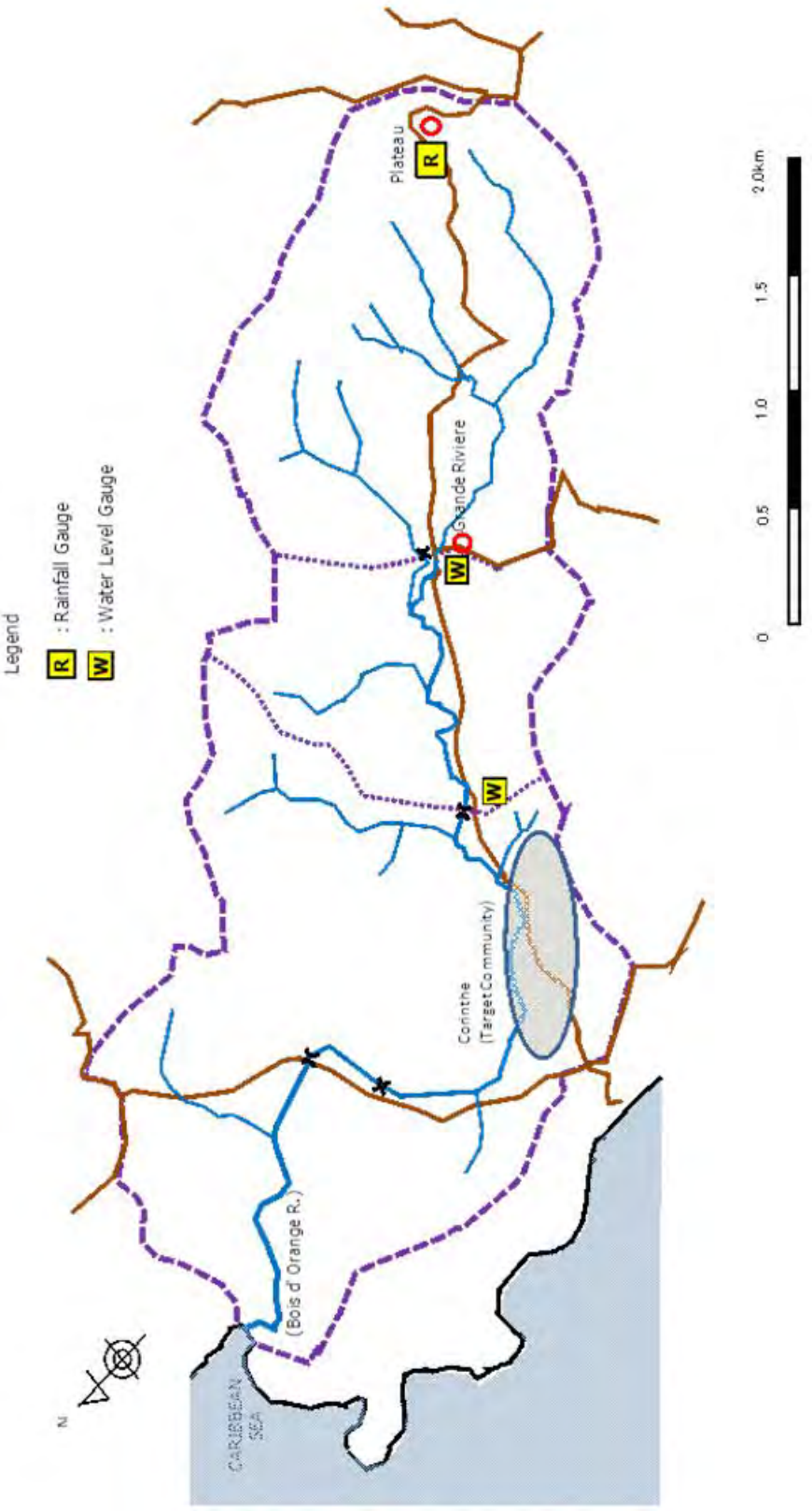


Fig. 3-4 Location Map of Pilot Site (5/5):
Corinth, Bois d' Orange River Basin, Saint Lucia

3.5 Community-based Disaster Risk Management

3.5.1 First Year

Activities of the first year are itemized as follows:

- Survey of the present situation of the community (from March 2009 to May 2009)
- Promotion of CBDRM activities in the pilot sites (from December 2009 to March 2010)

(1) Pilot community

Pilot communities had been already selected by the first country mission

Considering the first mission member's recommendation and the results of site reconnaissance survey and site rapid assessment as well as using the pre-set criteria for site selection, the CBDRM pilot sites were finally selected.

Table 3-11 Communities selected for pilot implementation

Pilot State	Pilot Community	Type of Flood experienced in the community
Belize	Crooked Tree	Slow-rising flood (inundation)
Dominica	Lower Bath Estate	Flash Flood
Grenada	Lower Balthazar Village	Flash Flood
Guyana	Upper Mahaica Community (Little Biaboo and Big Biaboo)	Slow-rising flood (inundation)
St. Lucia	Corinthe Housing Development	Flash Flood

(2) CBDRM activities

The activities were undertaken in all pilot states and summarized as shown in Table 3-12...

Table 3-12 Status of CBDRM Activities in the pilot sites (First Year)

Activities/Pilot Sites	Belize	Dominica	Grenada	Guyana	St. Lucia
Hazard Mapping	Done	Done	Done	Done	Done
Risk Assessment	Done	Done	Done	Done	Not done
Develop Evacuation Procedures	Risk Mapping	Done	Done	Done	Not Done
Develop community-based early warning and communication system	Done	Done	Done	Done	Not Done
Organize Community Emergency Preparedness Team	Done	Done	Done	Done	Not Done
Agreed Roles and Responsibilities	Done	Done	Done	Done	Not Done
Conduct community-based functional drill (evacuation drill)	Not Done	Done	Not Done	Not Done	Not Done
Action Plan for next Steps	Done	Done	Done	Done	Done

As can be gleaned from the above table, Only Dominica completed the full range of CBDRM activities as planned. The other pilot States did not complete the planning activities due to the following reasons:

Belize:
There was no sufficient time to organize the evacuation drill considering that residents of the flood prone areas and those who volunteered to be members of the Crooked Tree Emergency Committee work or undertake personal chores on the requested day and time for the drill. It was agreed that the drill shall be conducted on the next assignment with the proper coordination with the National Team.

Guyana:
Given the history of flooding in the Upper Mahaica communities, they have learned to live with flood. The common practice and which is supported by the Government, is to evacuate the animals before the rainy season. The first rain hints at future flooding and therefore, the animals need to be protected.
As they live with regular flood, the people know where to go and that is to stay at home at the safe area of their houses. Majority of the houses have second floors where the residents retreat during flood period. A few houses built close to the ground were identified and which residents need to move to safe areas.
The warning team was l organized in order to provide information on the status of the flood as well as any release of water from the conservancy. The evacuation drill was not done as it required more preparation and understanding of the role of the members of the team considering that this is the first time to have an organized team for flood preparedness.

Saint Lucia:
Except for hazard assessment which was conducted outside any workshop venue and with input from individuals, the remaining CBDRM activities were not undertaken as the residents need longer preparation time to come together as a community. During the first year implementation, only the first step in social preparation was undertaken - the sensitization workshop. During the sensitization workshop, it was agreed that the community need to be organized first before any CBDRM activities could be undertaken. To this effect, community organizers were identified who will also act as champion for the Project implementation...

Grenada;
As this is the first time the flood preparedness team was organized, the members need time to work as a tem as well as understand their roles and responsibilities in the event of a flood. At this time, the local indicators for evacuation warning was not established and therefore, it was decided that the evacuation drill be postponed to a later date.

Crooked Tree, Belize Flood Hazard Map as drawn by the community


Bath Estate Disaster Preparedness Team during Role Play (Day 4) - Dominica


Sensitizing workshop, Corinth, St. Lucia

3.5.2 Second Year

In the second year, the following activities were continued with the intention of reviewing, finalizing and/or completing the draft plan that was developed in the first year. The output of DIG activities is the warning and evacuation plan, the community-based warning system that uses local indicators to warn the people of the threat of flood as well as the community based organization in-charge of

implementing the plan.

(1) Implementation of DIG

This activity is composed of reviewing the plan with the national emergency management offices in each pilot state and the members of the National Team as well as reviewing with the residents. Community meetings were conducted to get a consensus on the content of the flood preparedness plan. The focus of the review and further development were: the warning and communication flow, the warning levels and the revision of the organizational structure of the flood preparedness team, as needed.

Table 3-13 Status of DIG Implementation after Second Year of Implementation

Activities/Pilot Sites	Belize	Dominica	Grenada	Guyana	St. Lucia
Plan review at the National Level	Done	Done	Done	Done	Not Done
Plan Review at the community level	Done	Done	Done	Done	Not done
Develop the Warning Communication Flow considering the gauges installed for the purpose of early warning	Done	Done	Done	Done	Not done
Update the organizational structure of the flood preparedness team and review the team members	Done	Done	Done	Done	Not done

The detailed activities in each pilot State are described below:

Belize:

Activities:

(1) Meeting with NEMO to review the draft community flood preparedness plan ensuring consistency with National Disaster Management Policy.

(2) Meeting with core members of the Crooked Tree Village Council and members of the Flood preparedness Team to review and finalize the Warning and Evacuation Plan of the pilot village with focus on the recommendations and comments of NEMO. The meeting also focused on the warning and communication flow from the National level to the village level. The list of families who need to move to temporary shelters was also updated especially identifying the private houses where those at-risk plan to move during the flood.

Achievements:

Second version of the Crooked Tree Flood Warning and Evacuation Plan was developed by the core team in Crooked Tree. This was presented to NEMO for further action especially on the recommended private houses that were identified as safe shelters.

Dominica:

Activities:

(1) Meeting with ODM to discuss the planned activities with the partner officers and plan for succeeding meetings.
(2) Meeting with National Team to present the status of the Community Disaster Management

Project as well as solicit the inputs and comments of the NT on the on-going CBDRM activities in the pilot site. Discussed and agreed on the warning and communication flow

(3) Meeting with Bath Estate Development Council to review of and finalize the Warning and Evacuation Plan of the pilot village taking into consideration of the recommendations and comments of the National Team. Revised organizational structure was considered.

Achievements:

(1) The Warning and information flow was agreed with the National Team along with recommendations on improving the first draft of the Bath Estate Flood Warning and Evacuation Plan.
(2) The leadership of Bath Estate plans to call a few meetings with the core team members in order to incorporate the recommendations of the National Team into the draft plan
(3) The National Team, specifically the ODM, will follow through the conduct of meetings at Bath Estate and to provide the necessary support to Bath Estate Development Committee.

Grenada:

Activities

(1) Meeting with National Team to discuss the content of the flood preparedness plan.
(2) Visited the pilot site, Balthazar village and organized meetings for the purpose of reviewing and revising the plan. The revision took into consideration the recommendations and comments of the NT.
(3) Discuss the conduct of the evacuation drill which is programmed for either October or November.

Achievements:

(1) The recommendations of the NT were incorporated in the draft plan.

(2) Finalized the list of the residents who are at risk to flooding and identified the safe houses where they will go in the event of a flood.

(3) Agreed on the community participation during the evacuation drill that is being planned for YR3.

Guyana:

Activities:

(1) Facilitated the review and revision of the warning and evacuation plan based on the current situation in the Upper Mahaica regional and using the latest changes in Guyana Response Plan.
(2) Assisted the community of Upper Mahaica to develop their action plan for capacity building and implementing the warning and evacuation plan
(3) Discussed the awareness-raising activities to disseminate the information on warning and evacuation procedures.

Achievements:

(1) The second draft of the Upper Mahaica Warning and Evacuation Plan was prepared and submitted to Civil Defense Commission for approval
(2) The action plan was developed and submitted to the Civil Defense Commission for consideration and implementation.
(3) Identified the responsible persons (team) to develop the awareness-raising materials and the program of dissemination. The Civil Defense Commission has been identified as the leader of the awareness-raising activities.

St. Lucia:

Activities:

(1) Meeting with NEMO and the National Team to discuss the planned activities with the members of the NT and plan for succeeding meetings.
(2) Meeting with core members of the Corinth Housing Development to develop the community-based flood warning and evacuation plan for the selected pilot site.

Achievements:

Another sensitization meeting was conducted in place of the planned CBDRM workshops. ST. Lucia NEMO has plans to work closely with the residents of Corinth in order to increase the interest in CBDRM. Sustaining this interest remains a big challenge to NEMO and the JICA Expert. Thus, it was agreed that regular communication between the JICA Expert, NEMO and the identified core individuals in Corinth is necessary even outside the assignment period of the JICA Expert in the Caribbean.

(2) Implementation of Flood Warning and Evacuation Drill

The flood warning and evacuation drill was not conducted during this period in due consideration of the followings which have impacts on the schedule of the evacuation drill:

The December 2010 mid-term meeting of the RT and the NT in Jamaica requested that an evacuation drill guide be prepared by the Expert with such guide to identify the resources needed for a successful evacuation drill. As it was needed time to prepare this guide, it was suggested that the evacuation drill be incorporated in the planned simulation exercise to be conducted after the installation and testing of the flood level gauges and rain gauges.

(3) Updating of Community Disaster Management Planning Manual

Community disaster management planning manual was updated and it was separately prepared and was submitted to CDEMA for further discussion.

(4) Preparation of Material for Disaster Management Dissemination

Enhancement of community awareness on disaster management is one of the vital parts for mitigation of flood disaster in the community. Preparation of dissemination material for enhancement of community disaster management was planned in this period. But due to various situations, the preparation of those materials was not conducted in this period.

3.5.3 Third Year

Activity period of the third year are divided into two, that is, from October to December 2011 and from April to June 2012. Activities and achievements of respective periods are summarized hereunder:

(1) Period from October to December 2011

(a) Implementation of DIG (CBDRM)

The DIG was implemented in St. Lucia as the only pilot site that had not been successful in the first two years of DIG implementation.

Activities:

(1) Meeting was held with NEMO and the National Team to discuss the planned activities with the members of the NT and plan for succeeding meetings. The flood warning system was presented with the intention of finalizing the warning levels for the pilot community.
(2) Meeting was held with core members of the Corinth Housing Development to develop the community-based flood warning and evacuation plan for the selected pilot site.

Achievements:

The warning levels were agreed during a meeting held with the NEMO, members of the NT, and the residents of the Corinth Area. The Warning and Evacuation Committee for Corinth Area was formed and the communication protocol was agreed.

In other pilot States, the Flood Preparedness Plan was reviewed, completed with the incorporation of the local indicators for evacuation warning.

In Dominica, a review of the flood hazard map prepared by the community took place... Further, with the changes in leadership of the community organization, the structure and members of the flood preparedness team was also revised.

(b) Implementation of Flood Warning and Evacuation Drill

The flood warning and evacuation drill was implemented with the intention of testing the content of the draft plan prior to finalization of the plan that was reviewed on YR2. The output of DIG activities was the tried and tested plan as well as the practice of the functions of the community disaster committee (flood preparedness team). The testing of the plan was in the form of an evacuation drill and functional exercise.

Belize

Activities:

(1) Meeting was held with NEMO to finalize the plan for the conduct of the evacuation drill and functional exercise at the pilot village.
(2) Meeting was held with core members of the Crooked Tree Village Council and members of the Crooked Tree Disaster Committee to prepare for the evacuation drill and functional exercise. The community-based flood warning was also discussed in conjunction with the discussion of the early warning system set up for Crooked Tree.
(3) Table top exercise was also introduced as one form of testing the reviewing the plan.

Achievements:

Conduct of functional exercise and evacuation drill where members of the disaster committee practiced their functions and role in flood preparedness as contained in the warning and evacuation plan for Crooked Tree.

Dominica

Activities:

(1) Meeting was held with ODM to discuss the planned evacuation drill with the members of the national team and plan for a series of meetings at the pilot community.
(2) Meeting was held with Bath Estate Development Council and the Bath Estate Disaster Committee to prepare for the evacuation drill and introduce the concept of functional exercise. The meetings also provided the opportunity to revise the flood hazard map based on the actual experience of the residents as well as agreement on the community-based

indicators for warning levels.

Achievements:

The evacuation drill was successfully conducted with the participation of the NT, residents, members of the Flood preparedness Team, and actual help of the ambulance service of the Fire Department Rescue Service.

Grenada

Activities:

(1) Meeting was held with the members of the NT and discussed the proposed conduct of evacuation drill and the review of the community-based warning levels as previously discussed between the NT members and the warning expert.
(2) Meeting with the residents of the pilot village as well as the members of the flood preparedness team was held.

Achievements:

The conduct of the evacuation drill using the newly agreed community based flood warning system. Changes to the warning and evacuation plan, specifically the bases for the flood warning using the community-based indicators have been incorporated into the plan. New members of the flood preparedness team were given the opportunity to practice their roles and responsibilities.

Guyana

Activities:

(1) Meeting was held with the national disaster management organization, CDC, to agree on the final approach to prepare for the evacuation drill that was proposed as a way of testing the plan.
(2) A series of workshops were held to further strengthen the procedure for evacuation drill, to prepare the residents and the members of the Flood Preparedness Team to participate in the evacuation drill and to agree on the local indicators that can be used for warning the people to evacuate as a complementary warning basis evacuation when the flood threatens the community.

Achievements:

Evacuation drill was conducted using the local indicators for warning.

(c) Updating of Community Disaster Management Planning Manual

Community disaster management planning manual has been updated/revised in keeping with the suggestions and comments made during the JCC meeting held in March 2011 and suggestions and recommendations given during the meeting held in August 2011. The planning manual is separately prepared and is submitted to CDEMA and RT for comments.

(d) Preparation of Material for Disaster Management Dissemination

Enhancement of community awareness on disaster management is one of the vital parts for mitigation of flood disaster in the community. Preparation of dissemination material for enhancement of community disaster management was planned in this period.

Table 3-14 Status of Project (CBDRM) Implementation by December 2011.

Activities/Pilot Sites	Belize	Dominica	Grenada	Guyana	St. Lucia
Warning System review at the National Level	Done	Done	Done	Done	Done
Warning System Review at the community level	Done	Done	Done	Done	
Update the organizational structure of the flood preparedness team and review the team members	Done	Done	Done	Done	
Flood Hazard Map Review at the National Level	Done	Done	Done	Done	Done
Agreement on the warning level with participation of NT and community members					Done
Organize the Flood Preparedness Team with the participation of community members and NT					Done
Warning communication flow and protocol from the National Level to the pilot community was established					Done

(2) Period from March to June 2012

(a) Finalization of CDM Planning Manual

The draft manual has been revised and edited incorporating the latest experiences on DIG and evacuation drill in the pilot States. New examples were incorporated and sustainability and maintenance of the community plans were added as activities during the post-planning phase.

(b) Implementation of DIG

(1) During the extension period, DIG has been used to finalize the warning and communication plan for the pilot communities integrating the finalized flood hazard map and early warning system with the incorporation of the community-based early warning system.
(2) The NT members of each pilot State and the pilot communities commented and suggested changes and improvement of the flood hazard maps. Important also is the integration and the correlation of the early warning system and the community indicators for evacuation. Each pilot community has developed its own community-based warning system.
(3) During the implementation of DIG, the National Emergency Management Offices and the members of the NT, started the transition to managing and facilitating the review and completion of the flood preparedness plan, conduct of evacuation drill.

(c) Conduct of Evacuation Drill

(1) Evacuation drill was conducted and evaluated. The drill was led by the NT with all members weighing in on the modality of the drill execution. The role of the other members of the NT during the early evacuation and response to a potential flood event was identified as in the case of Dominica and St. Lucia.
(2) The village disaster committee took all the initiatives in the operational activities and took full command of the evacuation drill.
(3) Evaluators/observers participated during the drill. A full evacuation drill was conducted in the Island States of Dominica and Grenada where flash flood is the focus hazard. A functional exercise demonstration and a table top exercise were conducted in St. Lucia.

During these exercises, the functions of the members of the team were practiced and articulated during the table top exercise.

(4) The continental pilot States of Belize and Guyana focused on inundation that, historically, stayed for long periods. Guyana National Team and the pilot community Flood Preparedness Team conducted the evacuation drill, prepared and organized the drill and finally implemented the evacuation drill plan. Belize National Emergency Office provided guidance on the conduct of the final project activities. Members of the flood preparedness team were active in the implementation of these final activities considering the challenges in evacuating the at-risk residents.

(d) Preparation of Material for Disaster Management Dissemination

Prepared materials for disaster management dissemination were used during the evacuation drills in the pilot sites. Materials include Poster, brochures, billboard constructed at the pilot site, polo shirts, T shirts, etc.

Table 3-15 Activities of The Extension Period

Activities/Pilot Sites	Belize	Dominica	Grenada	Guyana	St. Lucia
Finalize the warning and communication plan by integrating the early warning system and the flood hazard map	Done	Done	Done	Done	Done
Conduct of Evacuation Drill/functional and table top exercise	Done	Done	Done	Done	Done

3.5.4 General Overview

The following are the overview on the social characteristics of the community at the beginning of the project, intervention done during the project implementation and the social characteristics at the end of the project:

Table 3-16 Overview on the Social Characteristics of the Community

Pilot State	Social Characteristics at the beginning of the project	Intervention done during the Project implementation	Social Characteristics at the end of the project
Belize	The initial impression of social environment shows the following: a. Residents are not cohesive in terms of disaster response b. Residents are divided in terms of preparedness activities due to regular exposure to flooding c. There is no organized response to flooding hazard	The Project has undertaken the following activities that were instrumental in effecting change in the social setting of the pilot community: a. Social preparation to introduce the Project was well implemented in Crooked Tree introducing the need for cooperation and the value of working together towards a better flood warning response b. Workshop on introducing the different kinds of flood as well as the effect of climate change on flood intensity c. Organize a more responsive and more function-oriented Flood Preparedness Team	After the project implementation, the key residents exhibit the following characteristics: 1. The residents are now willing to work together towards improved disaster response especially after leadership has been defined 2. Residents have higher level of understanding that not all floods are the same and therefore, become united in identifying measures towards flood preparedness 3. Several key and respected residents are now organized as flood preparedness team and are regularly meeting to address potential for flood

			response.
Dominica	There are three (3) distinct groups of residents targeted by the Project mainly due to their location within Lower Bath Estate. These groups are independent of each other and do not exhibit social inter-action. Residents within each group react to a flood situation separately. The expression "to each his own" describes the separate grouping.	a. The Project encouraged the regular meeting of the members of the Disaster Committee especially after the demonstration of the importance of working as a team during early evacuation as shown by the evacuation drills b. The meetings addressed the separate and disparate needs of the at-risk residents of the three areas especially in assigning roles to key persons in matters of warning monitoring and warning dissemination.	The Project has helped some improvement in the manner by which the residents now interact with each other when faced by a threat of flood (or any other threat). After the Project, the key residents of the three groups get together as members of the Disaster Committee which is responsible for encouraging the residents to behave as one community. They have demonstrated that they can work together during the drills that the Committee plans to conduct a frequently as practicality dictates.
Grenada	The pilot site is relatively small community composed of about 50 families. There are very few opportunities for employment within the village and therefore some of them go out of the community to seek employment. Otherwise, the rest of the residents stay at home, watch cricket practice and limit their inter-action within the family members. The residents' social inter-action is influenced by political affiliations which gives the impression of a divided community. Response to flood was also done as uncoordinated effort by individuals. There was no organized group to assist the residents towards an early and organized flood response. The community also has canals that eventually drain water to the river. But when the canals are blocked with garbage, the danger of flooding the low-lying areas is increased.	The Project implemented the following: a. The importance of risk reduction measures that are specific to the community. This includes ensuring that the sources of flood are clean and free of garbage. b. That forming a Flood Preparedness Team is a critical factor in ensuring that the community is ready to face another threatening flood and that the Team should work together and cooperate with each other to be effective. c. Awareness raising is a good vehicle to inform the residents of the preparedness activities and the importance of everyone's cooperation in early evacuation.	The biggest change in behavior exhibited by the larger population is their willingness to work together despite their political affiliations. This was proven by the latest threat o f flash flood, in February 2012, when the flood preparedness group came out very early in the morning and worked towards alerting people, making sure that everyone knows what to do. It was reported that everyone cooperated. More people were more willing to participate in activities related to flood preparedness. The JICA Expert Team met more people at the end of the project who were interested to know how they can become part of the group and more people wanting to know how they can help in implementing the plan. The residents are now aware that cleaning the canals and other drains are measures that will reduce flood. Thus, they now avoid throwing garbage in the canals.
Guyana	The community is predominantly a farming community whose daily lives revolve around planting, nurturing and harvesting crops, interspersed with fishing, hunting and livestock raising. Because of this preoccupation, there is little time devoted to social interaction. Farmers belong to a local farmers cooperative whose members are mostly the male farmers. Due to	The Project intervened as follows: a. Introduced the role of CDC as the main national agency for flood response and preparedness b. Initiated and facilitated the conduct of action planning that identified the immediate actions to be taken up to wit: work with CDC on identifying	With the Project Intervention, the following behavioral modification has been observed: The residents now meet to discuss common concerns about animal safety and procedures for evacuating people and animals to pre-designated safe places. They, as members of the flood

	long history of flooding in the area, residents have developed an uncoordinated culture of coping with the floods as individuals (or as a family) instead of as "a community" and without external intervention. They depend on historical or traditional knowledge as basis for moving to safety.	a safe animal shelter, Develop the need for a two-stage evacuation and then sought the endorsement of CDC for such an approach and highlight the roles of the Flood Preparedness Team and CDC in an orderly and well - managed evacuation. c. The Project also introduced the need for regular interaction between the at-risk residents and the members of the Flood Preparedness Team and the high value of being a member of the Team.	preparedness team, now have a continuing dialogue with the CDC regarding the selection of safe place for animals, and also the use of the school and the health clinic as the location for level 1 evacuation followed by CDC-assisted move to relatives in safe areas of Guyana.
St. Lucia	The pilot site is a middle class housing development. Majority of the home owners are retirees from the USA, UK, and Canada who are St. Lucians by birth. They spend half the year in St Lucia and the other half in their other residence outside St. Lucia. There are also renters who have no experience of flash floods. The residents who belong to the employable group spend most times at work and do not have time to socialize with other residents as their time is consumed by work and domestic/family-related activities.	The Project sensitized the residents to the following: 1. The need for a more intense awareness-raising about flood preparedness. 2. An action plan has been discussed with the Leadership of the Flood Preparedness Team which includes inviting residents to a barbecue that may serve as a venue for discussion 3. A plan to invite key residents and members of the Flood Preparedness Team to participate in preparedness meetings of the District Disaster Committee so that the residents are aware of things that the Committee can do including the cleaning of drainage, cutting of trees that may pose additional danger and post-flood clean-up 4. The plan to invite more members of the Flood Preparedness Team	It is a big challenge to get the people to cooperate as one. The best thing that happened due to the Project is the willingness of the residents to come out and discuss any possible ways to be part of the warning system. The people are willing to talk to each other and some curiosity has been aroused in the residents to see what is going on especially during the demonstration of evacuation.

3.6 Hydrological Database and GIS

3.6.1 First Year

The first year activities related to the hydrological database and GIS are itemized to (1) GIS data preparation for FHM and (2) establishment of the hydrological database in CIMH.
Activities and achievements are summarized hereunder:

(1) GIS Data Preparation

Data Collection and Preparation
The topographical maps and data obtained during and after the first country missions were converted to necessary GIS formatted data with use of GIS software by CIMH. The data are mainly composed of DEM (topographical digital data), Shape files (geographical data) and Base maps for hazard mapping.

GIS Training Course at CIMH
GIS training course on GIS as well as flood analysis was held at CIMH. This course aims capacity enhancement on flood hazard mapping of CIMH and spillover of the project output into the Caribbean region. This training could be a foundation to establish the flood hazard mapping course in the current CIMH training courses. The contents of the training are shown in Table 3-17.

Table 3-17 GIS Training Curriculums

Session and Title	Contents
Introduction of GIS	- General and symbolizing on ArcGIS
Create and edit shape-files	- Create new shape files - Edit shape files and allocate attribution table
Import excel files / interpolation	- Create gauge station data (Point) - Precipitation distribution mapping
Geo-reference / Digitizing scanned map	- Geo-reference tool for scanned toposheet map - Digitize map data
Conversion of DWG / Create TIN data	- Import DWG (AutoCAD) maps - Create TIN and Grid file from contour lines
Hydrological Analysis	- Hydrological network analysis - Extract watershed area from Grid file
Runoff Analysis by HEC-HMS	- Watershed modeling on HEC-HMS - Tentative runoff analysis
Outline of HEC-RAS	- Basic function of HEC-RAS - Flood analysis using simple river model
Interconnected between ArcGIS and HEC-RAS	- Prepare geometry files and simulate on RAS - Flood inundation mapping on ArcGIS
Follow up session	- Flood inundation mapping

DWG = AutoCAD format file, SHP = shape file

Views of Training Course in CIMH

In order to serve this purpose, procurement plan of the GIS software was modified as shown in Table 3-18. This change will be able to 1) extend technical transfer for GIS analysis, 2) shear data preparation work for flood analysis, 3) conduct GIS training as well as flood analysis in the training course of CIMH and 4) reduce the total cost because of less cost of the "Educational Purpose License (LAB KIT)".

Table 3-18 Procurement Plan of GIS software

Item	Implementation Plan	Revised Plan
ArcGIS (ArcView 9.3)	1 license	15 license of LAB KIT
ArcGIS (ArcInfo 9.3)	-	1 license of LAB KIT
3D Analyst	1 license	16 license of LAB KIT
Spatial Analyst	1 license	16 license of LAB KIT

(2) Hydrological Database Preparation

Hydrological database that can be widely used in CARICOM with high versatility possible to make an access from any states in the Caribbean is established in CIMH.

Current Status of Hydrological Database in Caribbean region

Currently there are several countries managing their own hydrological database systems including stand-alone database system such as HYDATA and Microsoft Access, and also web-based application at Jamaica, St. Lucia and Grenada. On the other hand, it is difficult for some countries to manage such database system due to the limited human resources.

Key Issues of Hydrological Database

Considering these circumstances, the basic concept of hydrological database was discussed with CIMH, in consideration of related RT/NT opinions. As the results, the considerable key issues to develop database system were the followings:

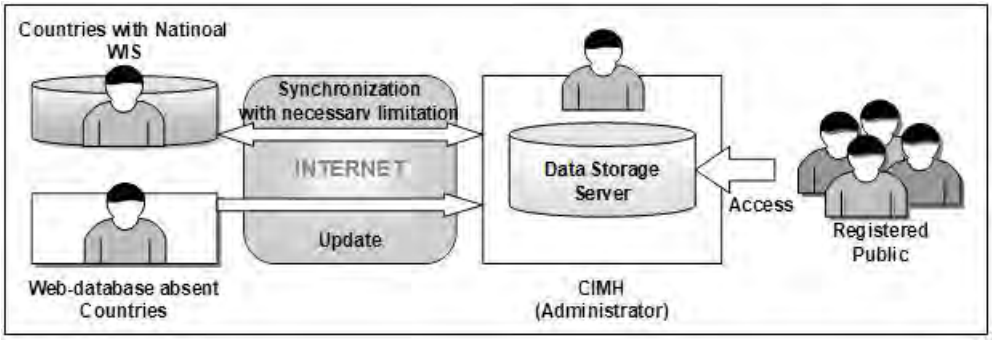
- To allow accessing and updating from all member countries.
  Currently CIMH is managing a stand-alone database covering the countries where it is difficult to maintain hydrological data due to limited human resources. This database manually stocks a number of hydrological data from CDEMA participating states. Replacing this database into web-database system will allow easy management and functional updating.
- To consider the countries where web-database has been already installed
  Jamaica, St. Lucia and Grenada have their own hydrological database system (Water Information System). Developing regional database system in CIMH tends to enforce them to update data to their database and also CIMH database. This will not be rational and functional from a viewpoint of sustainable maintenance.
- To be consistent of the framework of CIMH
  Since this hydrological database system shall be maintained and managed by CIMH in future, it must be developed with due consideration of the framework of CIMH, which aims at a comprehensive and sustainable hydrometric networks in the region.

Specifications of Hydrological Database

In consideration of the above key issues, specifications of hydrological database system were discussed with CIMH. The proposed specifications are follows:

- Install a web-based regional hydrological database system in CIMH, instead of the current stand-alone database system. This will allow storing data from various CDEMA participating states through the Internet.
- Establish synchronization link with the existing national water information system in Jamaica, St. Lucia and Grenada, so that CIMH database will be automatically updated without duplicated procedure.
- Establish water information system in Guyana and synchronization link with CIMH database as the template of future hydrometric networks in the Caribbean region.

Future Plan



After the Project (Tentative)

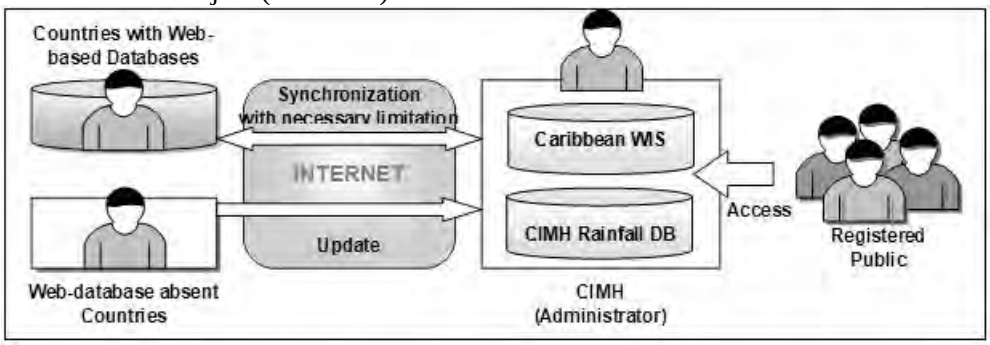


Fig. 3-5 Basic Concept of Hydrological Database

To achieve the above specification, a developer "CyberScript International", which has developed water information systems of Jamaica, St. Lucia and Grenada, was elected for the system development, and contracted on 20 August, 2009.

Setting up Database Server

The hydrological database server was set up in CIMH. A procured desktop computer (DELL OPTIPLEX 760) is used as the server machine, and "Apache" and "MySQL" were employed as web-server application and database engine respectively. The specifications of the web-server are shown in Table 3-19.

Table 3-19 Specifications of Database Server

Item	Spec.
CPU	CORE 2 DUO 3.0 GHz
RAM	4 GB
HDD	160 GB
OS	Windows Vista Business
Web-Server Application	Apache 2.0
Database Engine	MySQL

The database system "Caribbean Hydrological Database" was installed and data transportation from existing CIMH database to the system just started by CIMH.

3.6.2 Second Year

The main activity related to Hydrological Database and GIS in the second year is to evaluate and revise the system and to conduct training of utilization and data-input.

(1) Outline of Hydrological Database

There are 2 types of hydrological database developed in CIMH. One is Caribbean Water Information System (WIS) and the other is CIMH Rainfall Database as shown in Fig. 3-5.

Caribbean Water Information System

The Caribbean Water Information System (WIS) was developed in CIMH based on the frame work on water information management of CIMH. This system allows connecting to web-based databases developed in several counties, Grenada, St. Lucia, Jamaica and Guyana (Country DBs: WebMap). The data accumulated in each County DB are automatically updated to CIMH main server (WIS) through TCP/IP connection. All administrative issues on hydrological data including user registration are under responsibility of each country, and CIMH can behave as a data-storage for emergency case. In this project, Guyana is experimentally added into this information network.

CIMH Rainfall Database

Currently CIMH is managing a stand-alone MS Access database covering the entire Caribbean region, where enormous amount of rainfall data (mainly daily rainfall) have been accumulated more than a hundred year. Such daily rainfall / monthly rainfall can be well used for long-duration precipitation analysis. The newly developed CIMH Rainfall Database is a replication that allows accessing and updating data though the internet from any states in Caribbean region.
This database system is just tentative. All of system must be integrated into Caribbean Water Information System under initiative of CIMH in future.

(2) Evaluation of the Database System

Although the main part of Hydrological database was completed in the last year, it needed some modifications for practical operation and data updating. Especially user registration is one of the key issues to open to the public. In the system, there are 3 types of accessible Users, namely CIMH Administrator, Country Administrator and Public User as bellow.

1) CIMH ADMINISTRATOR – This user has full access to the database and can add, edit, delete, view, export data for all countries in the database. The Administrator can register for all of Country Administrators and Public users.

2) COUNTRY ADMIN – This user is granted access to an individual country and can add, edit, delete, view or export data only for the country for which the user has access. The Country Administrator can register and provide ID and Password for publics in their country.
3) PUBLIC – This user has access to only one country, and can only view the data for that particular country. The public user cannot add, edit or delete data.

Additionally some other functions such as searching of existing data and show charts were set in the second year for better usability.

Table 3-20 Access Authority

User Level	Agency	Available Country	Available Function	New User Registration
CIMH Administrator	CIMH	Any countries	Add, Edit, Delete, View	Administrator Country Admin Public User
Country Admin	e.g. Hydro-Met in each country	Registered country	Add, Edit, Delete, View for only country	Country Admin Public User
Public User	Related organization in each country	Registered country	View	None

(3) Progress and Training

Caribbean Water Information System

Currently the web- based hydrological database in Grenada (WebMap) was connected to CIMH server, and the entire data is automatically updating to CIMH main server. As for Guyana installed as experimental system in this project, training on data-input and updating was completed on 18 and 22 February via remote access with participation of Hydro-Met Service in Guyana, system developer and the JICA expert.

CIMH Rainfall Database

Since several modifications were needed, the outline and data-input process into the database system were explained and discussed with CIMH hydrological section on 3 March. Most of existing data was transferred from MS Access DB.

Training on Utilization of Rainfall Data and Database

The utilization of accumulated data is one of the key issues for future sustainable operation. Originally this training was planned to separately conduct as database training. However it was conducted prior to the Flood Hazard Mapping Training intended for NT on 7 March, 2011, so that the participants can recognize the importance of continuous data accumulation and how to utilize for flood hazard mapping. The contents of the training were follows:

Table 3-21 Contents of Training on Utilization of Rainfall Data (7 March 2011)

Procedure of Flood Hazard Mapping:	To know entire procedure of flood hazard mapping and the orientation of precipitation analysis / rainfall data
Probability Rainfall (Return Period):	To know outline of flood designing using statistical method.
Rainfall Intensity & Duration:	To know “Intensity Curve” and the utilization
Data Processing from Rain Gauge:	To know data processing from self-recording type rainfall gauge
Data Processing from Rainfall DB:	To know data accumulation and extraction from CIMH Rainfall DB
Statistical Analysis:	To know statistical method to analyze precipitation data

Training on Utilization of Rainfall Data and Database in CIMH

3.6.3 Third Year

The main activities in the third year period are dissemination and data-input training as well as evaluation.

(1) Implementation of Training for Hydrological Database Input & Sharing

In this period, JICA expert and an official of CIMH visited the countries as shown in Table 3-22 for the purpose of data investigation, dissemination and data input-training. As St. Lucia has just launched NWIS during the visit, it was confirmed to be connected to CIMH server as soon as it would be opened to internet. St. Kitts / Nevis and Montserrat were not selected as pilot country in this project, whereas data investigation and locating have been conducted in cooperation with Caribbean Climatological and Hydrological Data Rescue project as referred to hereinafter.

Table 3-22 List of Countries where training was conducted in third year

Country	Period	Agencies
St. Lucia (Pilot Country)	11 – 14 Jul, 2011	Water Resources Management, Ministry of Agriculture and Meteorological Service
Dominica (Pilot Country)	19 – 21 Jul, 2011	Dominica Meteorological Service, Ministry of Public works, Energy and Ports
Belize (Pilot Country)	26 – 29 Jul, 2011	Belize National Meteorological Service, Ministry of Natural Resources and Environment
St. Kitts and Nevis	22 – 24 Nov, 2011	Meteorological Service. Water Service Department, Department of Physical Planning and Environment
Montserrat	22 – 26 Nov, 2011	Meteorological Service. Water Resources Department. Ministry of Agriculture.

On the other hand, Grenada's NWIS has been constantly updated and synchronized with Caribbean WIS in CIMH server as well. Further, the CADM2 installed NWIS at Hydro-meteorological Service in Guyana in July 2011, and the launching ceremony was held with attendance of Minister of Agriculture on 5th August, 2011. Although the connection with CIMH server has not been completed yet due to some network problems, data has been updated steadily.

Table 3-23 Countries managing NWIS and Caribbean WIS

Country	Launched Date	Responsible Agency
Grenada	26 Jan, 2009	Land Use Division, Ministry of Agriculture Water Information System set up by CARIWIN by CIDA/ McGill University. CADM2 supported data synchronization with CIMH server.
Guyana	5 Aug, 2011	Hydro-meteorological Service, Ministry of Agriculture CADM2 supported the system/software and training whereas Guyana side absorbed hardware. It was launched in 5th August, 2011.

Training at Belize Met Office

Guyana NWIS launching ceremony

(2) Evaluation of Activities for Hydrological Database Establishment

Evaluation as of May, 2012 was conducted according to the criteria in PDM. The evaluation results are show in Table 2-10. It is judged that the outputs related to Hydrological Database Establishment were achieved through the activities.

3.7 Institutionalization of NT System

3.7.1 Terms of Reference for National Team

In order to summarize the activities of this component, it is meaningful to look back on the past to see how things were at that time when the project was to start.
The draft Terms of Reference (TOR) for the National Team (NT) of the Caribbean Disaster Management Project Phase 2 which was presented at the First Joint Coordinating Committee Meeting on April 30, 2009 explains well to some extent about the project background and the planned roles of the NT at the initial stage as following.

Background (Note: Flood Early Warning System is missing in the TOR)
The goal of this three year project is to build the capacity of CDERA (now CDEMA) and five (5) of its Participating States for managing the flood hazards. The emphasis on this hazard is in keeping with findings of the Status of Disaster Preparedness in CDERA.

Participating States conducted in May 2001 which identified floods as the most common event – occurring in 90% of CDERA Participating States in the last five years, however in contrast only 25% of these countries have any plans in place to guide disaster management activities for this hazard.
Flood Hazard Mapping and Community Disaster Management Planning incorporating the result of the mapping are the important and initial steps to achieve the goal. However in view of the rather high technology and costly equipment required for the flood hazard mapping, it is hardly possible for each Participating State to possess this technology and equipment. The most practical and effective way is to have a team of qualified expertise and equipment in CDERA (Regional Team) which would prepare flood hazard maps and community disaster management plans in cooperation with a group of stakeholders to be established in each members state, each time the flood hazard mapping is proposed.
The Project intends to therefore, through pilot works at the five countries, primarily to train professionals of the regional institutions to establish a Regional Team (RT) who will collaborate with NT established in these countries. The Project will seek to examine the effectiveness of using this collaborative arrangement as a mechanism for flood hazard mapping and community disaster management planning. **If such a mechanism proves to be effective, a similar mechanism will be applied to other States in the future.**

National Implementation Arrangements
Sustainability of the infrastructure established through the Project for transferring the technical knowledge from JICA to the pilot countries will be critical for transferring the technical knowledge to the entire Caribbean region.
National ownership of the Project initiatives will be an essential building block on which future interventions can be established.

National Teams
At the national level, the focal point will be supported in the project implementation through NTs. Since the pilot projects are being carried out for the primary purpose of training the RT, NTs will collaborate with the Regional Team, who in concert with the JICA Expert Team, will provide technical expertise for Flood Hazard Mapping and community Disaster Management Planning.
Existing national mechanism may be utilized in the identification of the NT. Viewing disaster management as a development issue, taking into account the need to promote project outcome sustainability and recognizing that flood hazard mapping, mitigation and management are not solely the domain of National Disaster Offices, the NTs will comprise a broad range of relevant stakeholders including Private sector and Non-Governmental Organizations and Community based organizations who will be responsible for the pilot project implementation.

Roles of NT

- To support the National Focal Point in the execution of the project activities at the national level;
- To be a cooperating body for the implementation of the project at the national level in collaboration with the RT

NT will responsible to:

- Ensure effective communication, coordination and participation of national agencies and civic society groups in all aspects related to the project;
- Provide technical support in all matters related to the implementation of in-country project activities;
- Coordinate and support the execution of all the project activities in which the government participates;
- Select pilot areas/communities and delimit planning areas;
- Install and maintain Hydrological-Meteorological Observation and other equipment to be provided by the project;
- Devise long-term national institutional mechanisms for sustaining the CADM2 initiative

The draft TOR pointed out the importance of maintaining the installed hydrological stations by each NT and the key role of NT in sustaining CADM2 initiative in the future. These points are worth of notice.

3.7.2 National Disaster Office of Each Pilot State

In order to confirm the leading disaster management office of each pilot state, following information was collected from Web site of each organization.

National Emergency Management Organization (NEMO), Belize

(1) Mission Statement

NEMO in cooperation with the respective Emergency Management Committees, and all Public and Private Agencies, is established to preserve life and property throughout the country of Belize in the event of an emergency, threatened or real, and to mitigate the impact on the country and its people.

(2) Composition

The NEMO comprises the Cabinet, with the Prime Minister as the Chairperson, the Cabinet Secretary, as Secretary, the NEMO Secretariat and the 10 Operational Committees (chaired by Permanent Secretaries). The ten Operational Committees are as follows:
Education, Communication and Warning; Medical and Relief Measures; Housing and Shelter; Search, Rescue and Initial Clearance; Collection Control and Distribution of Food and Material; Assessment and Evaluation of Damage; Foreign Assistance; Transport; Environment and Utilities.
The other permanent members are the Belize Red Cross, the Belize Teachers Union, the Chief Meteorological Officer, the Commandant BDF and the Commissioner of Police. Integral to NEMO are its 9 District Emergency Committees (chaired by the senior Minister in each District) representing Belize, Corozal, Orange Walk, Cayo, Stann Creek, Toledo, Belmopan, San Pedro and Caye Caulker.

Office of Disaster Management (ODM), Dominica

(1) Mission Statement:

The Office of Disaster Management is committed to taking proactive and timely measures to prevent or reduce the impact of disasters on the Dominican people and economy through its efficient staff and collaborative efforts with national, regional, and international agencies.

ODM works closely with the National Emergency Planning Organization (NEPO) a governmental organization with responsibility for the planning and organization of counter-disaster measures at central level.
One of NEPO's key functions is to develop, operate, and maintain a National Emergency Operations Centre in accordance with requirements specified in the National Disaster Plan. More information on the role and functions of NEPO can be found in the National Disaster Plan 2001.
Together, the ODM and NEPO coordinates the overall Disaster Management programme based upon the principles of prevention, mitigation, preparedness, response and recovery:

Mitigation
- conducting hazard and risk assessments,
- developing and implementing mitigation strategies,
- prioritizing and implementing mitigation activities

Preparedness
- developing and maintaining a National Disaster Plan,
- developing and maintaining an Emergency Operations Centre,
- informing and educating the population about threats and counter disaster measures,
- training disaster service agencies and the public in counter disaster techniques and
- testing and exercising the National Disaster Plan

Response
- warning and evacuation,
- emergency medical and social services,
- search and rescue,
- building or facility damage assessment, and
- security and protection of property.

Recovery
- restoration of economic and social activities,
- resumption of services, and
- repair or reconstruction of facilities

The ODM is managed by the National Disaster Coordinator, under the direction Permanent Secretary and Minister for National Security, Immigration and Labour.

National Disaster Management Agency (NaDMA), Grenada

(1) Background

The National Disaster Office, the National Disaster Management Agency (NaDMA) was established in 1985 under the then name national Emergency Relief Organization (NERO). In 2005, on a conclusion of Cabinet, the name was then changed to the National Disaster Management Agency to more adequately reflect the mandate of the Agency as that of the historic management emergencies and not solely for the purpose of relief and response. The Agency continues to empower communities by building their capacity and encouraging them to take ownership of the many projects which they will be involved in.
In 1985 the first draft National Disaster Plan was developed; a model which triggered today's representation. In October 2004, a mandate was agreed to in Cabinet to change the name from the National Emergency Relief Organization, to the National Disaster Management Agency (NaDMA). The purpose was to more adequately reflect the mandate of the Agency as one of disaster management and not just response. Also the Agency is committed to embracing the holistic effort of comprehensive disaster management as stipulated by CDEMA and thus this change was seen as quite

timely.
A full time National Disaster Office (NDO) was established in 1996. It acts as a secretariat for NaDMA and is responsible for the day to day administration and execution of disaster management policies and programs. This involves working with the public and private sectors, non-governmental and voluntary organizations, communities and individuals to prepare for and respond to various emergency situations.

NaDMA is a participating state of the Caribbean Disaster Emergency Management Agency which is the inter-governmental agency established by the Conference of Heads of Government of the Caribbean Community in September 1991.

(2) Mission

The mission of NaDMA is to reduce the loss of life and property within Grenada, Carriacou and Petit Martinique by ensuring that adequate preparedness, response and mitigation measures are in place to deal with the impact of hazards. The vision of the Agency is to develop a culture of prevention and safety among all sectors of society. E NaDMA has five main groupings: Executive Council, the National Emergency Advisory Council (NEAC), Management Committees, District Committees and Village Committees

Civil Defence Commission (CDC), Guyana

(1) Background

The Civil Defence Commission (CDC) was established in the year 1982 to make plans and conduct operations to deal with all types of disasters in Guyana. By 1985 a comprehensive National Disaster Preparedness Plan was documented and put into use.
At the time of its establishment the Commission operated under the authority of the Office of the Prime Minister. Responsibility for the CDC was subsequently moved to the Office of the President in 1992.
In September 2001 Standard Operation Procedures for the National Emergency Operations Centre were upgraded to meet new challenges of the worsening domestic and international disaster situation.
The CDC of Guyana is a full member of the Caribbean Disaster Emergence Management Agency (CDEMA).

(2) Functions of the CDC

The Commission will function as follows:

- Service Provider: Promoting its role of providing services to local authorities/communities and for that purpose, to develop programmes designed to enhance those services.
- Planning and Implementation: Ensuring the promotion and development at national level of disaster planning and management and, in co-operation with local authorities, facilitating the implementation of disaster management measures for the purpose of emergency relief and support;
  - Loss reduction and Mitigation - Promoting the adoption of disaster loss reduction and mitigation policies and practices at the national and local authority level;
  - Voluntary Service: The promotion and development of voluntary service as an integral aspect of disaster management;
  - Training and Education: To establish and promote the development, maintenance and improvement of the tenants of disaster management training and education; and
  - Permanent Staffing: Maintaining a permanent body to enhance the national capacity for disaster management services.

Responsibility for disaster management in Guyana extends to every individual, family, community, government and private sector organizations. The Civil Defence Commission coordinates the national system with these bodies and is committed to initiating and supporting the disaster

management process throughout Guyana.

(3) Imminent Developments

The Government of Guyana is inclined to adopt a comprehensive reform process to modernize the Civil Defence Commission (CDC) and to bring it in line as much as practicable with the policies of CARICOM's umbrella agency for disaster management.
The reform process will involve among other measures, the revising of the outdated National Disaster Preparedness Plan to make the CDC compliant with global and regional systems such as United Nation International Strategy for Disaster Reduction and the Caribbean Disaster Emergency Response Agency's (now CDEMA) Comprehensive Disaster Management Framework. Implementing disaster preparedness legislation and upgrading infrastructural facilities will be completed as well.

National Emergency Management Organization (NEMO), Saint Lucia

(1) Background

National Emergency Management Organization (NEMO) is responsible for disaster preparedness and disaster response co-ordination. Disaster Management, though called by numerous names over the years has manifested itself constantly in Saint Lucia. As far back as June 10 – 20, 1979 Saint Lucia was host to the Caribbean Disaster Preparedness Seminar, where over one hundred and fifty delegates from the Caribbean, North and Latin America assembled to discuss the concerns of the day. The following year Hurricane Allen blasted Saint Lucia. A year later in 1991 Saint Lucia, together with fifteen other Caribbean States signed the Articles that created the Caribbean Disaster Emergency Response Agency (CDERA, now CDEMA) Disaster Management in Saint Lucia is conducted on a voluntary basis and during an event NEMO is part of a larger network that comes into existence to respond to a disaster. There are various Ministries that are essential to a response action. There are also eighteen (18) District Committees that are composed similarly to the national committees, which are composed of representatives of various Ministries and Social Groups. For a response action the national personnel contact his/her local counterpart and together execute an action.

(2) Mission Statement

The role of the National Emergency Management Organization (NEMO) is to develop, test and implement adequate measures to protect the population of Saint Lucia from the physical, social, environmental and economic effects of both natural and man-made disasters. Its responsibility is to ensure the efficient functioning of preparedness, prevention, mitigation and response actions. The National Response Plans for Saint Lucia are all at various levels of approval. Once they have met the full approval process they shall be available to the public. The plans are all "stand alone" documents that may be activated to support hazard management plans.

(3) National Disaster Management

National Disaster Management is very active and well developed. Saint Lucia has achieved Disaster Management capabilities which other Caribbean countries can follow. Numerous agreements with the private sector, NGO's, Service Organizations, and neighboring French Departments have been implemented. Health sector mitigation activities have begun and are expected to continue. St. Lucia has all possible disaster plans available and updated.

3.7.3 Objectives of Institutionalization of NT System

In order to sustain the outputs of CADM2, it is indispensable to draw up the sustainable National Team organizations with stronger coordination and synergy of activities of the related agencies in each pilot state. Without the concerted networking of the stakeholders, it is not possible to maintain the established CDMP, FEWS and developed FHM as practically operational and effective in enhancing resilience of the targeted communities of the project. The point of activity of this

component is to specify each stakeholder's role and responsibility and materialize the activities by all concerned stakeholders efforts in achieving the project outputs during the project period. Also as the TOR for NT indicated, a long-term national institutional mechanisms for sustaining and application of the CADM2 initiative to other flood vulnerable communities will become more possible by this component.

As agreed at JCC on December 14, 2011, JICA Expert Team will assist in establishing the National Team organization that will take over, maintain and utilize the outputs of the Project in the respective states. NT is a group of organizations including private sector and NGO designed to carry out CADM2 activities effectively in each pilot state during the project period. Basically, NT system is a temporary setup for CADM2. Therefore after completion of the project, NT system will be dissolved. Without existence of the responsible body to take care of CADM2 outputs, the established disaster management system may possibly be weakened.
It is expected that enhanced NT system will take the leading role in applying CADM2 initiative to other flood prone communities in each pilot state in the future.

NT system should continue to exist even after the project termination. As a best solution, Memorandum of Understanding is prepared by precisely reflecting the actual activities rendered by all the concerned parties during the project period.

3.7.4 Procedure and Approach of the Activities

Key principles
Aiming to maintain and utilize the outputs of the Project in the respective states, following key principles are applied for an institutionalization of NT System.

- With a goal of establishment of a long-term national institutional mechanisms for sustaining and application of the CADM2 initiative,
- To draw up the sustainable National Team organizations with stronger coordination and synergy of activities of the related agencies,
- To specify each stakeholder's role and responsibility and

Activity of this component was carried out basically in the following manner.
1st stage (December 2011 – January 2012)

- Review present disaster management policies and regulations
- Clarify present disaster management regulation and institution and main tasks and responsibilities of respective agencies organizations
- Clarify tasks and duties of respective agencies for activities of CADM2

2nd stage (January – February 2012)

- Detailed study and analysis on NT structure after CADM2

3rd stage (March – May 2012)

- Proposal and consultation on NT structure after CADM2
- Memorandum of Understanding prepared for each pilot state

In the course of the activity, following particular matters were considered.
(1) Role of Agencies
(2) Tasks and duties of the concerned organizations for following components

- Hydrological database
- FEWS (Flood Early Warning System)
- FHM (Flood Hazard Mapping)
- CDMP (Community Disaster Management Planning)

In January 2012, 1st country mission was conducted to Dominica and in February 2012, 2nd country mission was conducted to Guyana, St. Lucia and Grenada, and 3rd country mission was conducted to Belize in April 2012 to make the initial interview survey on existing legal system regarding disaster management and to discuss on incorporation of CADM2 NT System into each state's disaster management legal system or national disaster management plan. Thereafter continuous face-to-face discussions and the communication by e-mails and telephone calls were conducted.

Activity Steps

1. Specify the projects outputs to be maintained
2. Always grasp the progress of each component of the project
3. Prepare a draft questionnaire to be sent to each NT
4. Review the draft by the team
5. Send the questionnaire sheet to NT (deadline should be indicated)
6. Collect and review the questionnaire sheets
7. Make appointment with leading NT by e-mail and telephone call
8. Face-to-face discussion to clear the obscure points and express of intention about MOU to NT
9. Presentation of the draft MOU to NT
10. Hearing about the draft MOU from NT
11. Make necessary revision or amendment to the draft MOU
12. Finalization by NT

3.7.5 Memorandum of Understanding

It was understood that legalization would take a long time. Then in order to cope with this situation, a Memorandum of Understanding was drafted for each pilot state.

- It is a useful practical document. Memorandum of Understanding is a kind of very practical Standard Operation Procedure to keep CDMP, FEWS, FHM operational and practical.

- To materialize the activities by all concerned stakeholders efforts in achieving the project outputs during the project period.

- Memorandum of Understanding is to define the following tasks and responsibilities of each organization for CADM2 to sustain and improve the established FEWS and CDMP, and to maintain and improve the developed FHM and Hydrological Database.

1. Overall Responsibilities
   - 1.1 Leading role in NT
   - 1.2 Coordination of stakeholders(maintenance)
   - 1.3 Coordination of stakeholders(new community)
   - 1.4 Addition of new stakeholder
   - 1.5 Arrange necessary budget measures
2. Community Disaster Management Plan (CDMP)
   - 2.1 Maintenance of established Balthazar system
   - 2.2 Arrange necessary budget for maintenance
   - 2.3 Application of CADM2 CDMP to other community
   - 2.4 Arrange necessary general budget for new application
   - 2.5 Arrange necessary budget for facilitator
3. Flood Early Warning System (FEWS)
   - 3.1 Maintenance of existing FEWS
   - 3.2 Improvement of existing FEWS
   - 3.3 General upkeep of monitoring stations
   - 3.4 Correlation analysis
   - 3.5 Telecommunication setup(existing)
   - 3.6 Coordination of stakeholders
   - 3.7 Arrange necessary budget for maintenance/improvement
   - 3.12 Correlation analysis for new communities
   - 3.13 Planning of FEWS for new communities
   - 3.14 Decision of specification of hydrological gauges
   - 3.15 Selection of installation sites of hydrological gauges
   - 3.16 Installation of hydrological gauges for new communities

3.8 Selection of new target community
3.9 Development of FEWS for new communities
3.10 Collection of hydrological data for new communities
3.11 Collection of geological data for new communities
3.17 Operation & maintenance of new monitoring stations
3.18 Operation & maintenance budget
3.19 Monitoring of operation & maintenance works
3.20 Arrangement of general budget for FEWS

4. Flood Hazard Map (FHM)
4.1 Maintenance & improvement of developed FHM
4.2 Selection of new target community
4.3 Planning of FHM for new community
4.4 Field investigation
4.5 Preparation of hand drawn map
4.6 Mapping of field investigation result
4.7 Arrangement of necessary budget

5. Hydrological Database (HD)
5.1 General upkeep of existing monitoring stations
5.2 Data download
5.3 Data sharing
5.4 Monitoring of download works
5.5 Financial arrangement of data base system

- Memorandum of Understanding also aims to apply the CADM2 initiative to other flood vulnerable areas in each pilot state. Following items are mainly described in MOU.
  - Flood vulnerable communities
  - Risk level
  - Target Year
  - CBDMP (Status, Partner)
  - FHM (Status, Partner)
  - FEWS (Status, Partner)

- Then it can contribute in enhancing the resilience of communities which are suffering from habitual flood disasters.

3.7.6 CADM2 Outputs to be Maintained and Utilized by MOU

Outputs of CADM2 in each pilot state that should be maintained are as shown in the following table. These assets shall be taken over by NT of each pilot state. This will be put in a written form as MOU.

Table 3-24 CADM2 Outputs to be maintained and utilized in each pilot state

Pilot State	Description
Belize	Hydrological monitoring station -Isabella Bank (Water level gauge) -Big Falls (Water level gauge) -Banana Banks(Water level gauge) -Sta. Familia (Water level gauge) -Sta. Familia (Rain gauge) FHM for Crooked Tree Community FEWS for Crooked Tree Community CDMP for Crooked Tree Community Hydrological Database
Dominica	Hydrological monitoring station -Palm Grove (Water level gauge) -Morne prosper (Rain gauge) -Freshwater Lake (Rain gauge) FHM for Bath Estate Community FEWS for Bath Estate Community CDMP for Bath Estate Community Hydrological Database

Pilot State	Description
Grenada	Hydrological monitoring station -Grand Etang (Rain gauge) -Morne Longue (Rain gauge) -Castaign Bridge (Water level gauge) FHM for Balthazar Community FEWS for Balthazar Community CDMP for Balthazar Community Hydrological Database
Guyana	Hydrological monitoring station -St. Cuthbert's Mission (Water level gauge) -St. Cuthbert's Mission (Rain gauge) -Maduni Gate (Water level gauge) -Biaboo (Water level gauge) FHM for Upper Mahaica Community FEWS for Upper Mahaica Community CDMP for Upper Mahaica Community Hydrological Database
Saint Lucia	Hydrological monitoring station -Plateau (Rain gauge) -Grande Riviere (Water level gauge) -Corinth (Water level gauge) FHM for Corinth Community FEWS for Corinth Community CDMP for Corinth Community Hydrological Database

3.7.7 Initial Findings by Questionnaire Survey

Data with regard to legal structure of each pilot state was collected by questionnaire and interview survey method. Survey results are as shown in the following table.

Table 3-25 Current situation of legal structure in the field of disaster management

Pilot State	Disaster Management Act	National Disaster Management Plan
Belize	Disaster Preparedness and Response Act (2003) is under revision process. By June 2012, the Act is scheduled to be approved by the legislature. Mandate of NEMO will be expanded to cope with full range of disaster management activities, from disaster response to disaster risk reduction (preparedness and mitigation).	A newly established ministry, the Ministry of Local Government, Rural Development, Labor and National Emergency Management is responsible for NEMO, Met Service and Fire Fighting. Before, Met Service came under another ministry. From now on, whole disaster management system shall be more streamlined and strengthened under the new regime. Maintenance Manual National Meteorological Service has prepared "Maintenance and Downloading Instructions for Automated Hydro-stations" by themselves. This manual includes all aspects of the hydrological station from basic maintenance

Pilot State	Disaster Management Act	National Disaster Management Plan
		check list to data download and where possible advice on dealing with potential problems that may occur (troubleshooting). A soft copy of this 9-page manual is available.
Dominica	Dominica Emergency Planning and Disaster Management Act (2006) was drafted but not enacted. National Disaster Management Bill (2010) based on CDEMA Model 2010(*1) was drafted.	Government of the Commonwealth of Dominica National Emergency Management Plan (2010) was drafted.
Grenada	Disaster Management Act based on CDEMA Model 2010(*1) was drafted and waiting for the approval by the Legal Department.	National Disaster Management Plan (2011) has been approved by the Legal Department and approval by National Emergency Advisory Council (NEAC) is expected in September 2012.
Guyana	Disaster Response Management Act is to be drafted in 2012.	Multi Hazard Preparedness and Response Plan (2011) was drafted. Flood Preparedness and Response Plan (2011) has been drafted. It is confirmed that incorporation of CADM2 NT System into the National Multi Hazard Preparedness and Response Plan may be possible. National Early Warning System of Guyana indicates Technical Support Group. In this Group, DIGICEL, GT&T, UNICEF are included.
Saint Lucia	Disaster Management Act (2006) is in force.	National Emergency Plan is in force. National Flood Plan is in force. In the National Emergency Plan, a flood committee is not included now. In order to incorporate CADM2's NT system itself as a flood committee into the plan, a TOR for the Flood Hazard Mitigation Committee had been prepared. It is expected incorporation of the flood hazard mitigation committee will be realized around middle of March 2012. At Corinth, CADM2's target community, the Community of Corinth (Quarter of Gros Islet) had prepared their own FEWS Standard Operating Procedures. This Procedure was produced by using CADM2 Manuals. This is a highly recommendable

Pilot State	Disaster Management Act	National Disaster Management Plan
		example of self-supporting community based disaster risk reduction movement. It is confirmed that CADM2's draft Manuals are being shared among NT members and the manuals are regarded as vital documents for NT to replicate CADM2 system to other areas in the future. Australian donor has committed in a project that will adopt same type of FEWS introduced by CADM2 in their project in four communities in St. Lucia. In addition to this project, in a flash flood prone area, Soufriere, which located in southwest coast of the island, same hydrological gauges are to be installed for flood risk reduction. Financial assistance by CDM-HIP will be utilized.

Note
(*1) CDEMA Model
A model national disaster management policy was developed by CDM-HIP (Comprehensive Disaster Management Harmonized Implementation Programme). CDM-HIP is to enhance institutional support, and alleviate the effects of climate change and disasters by improving communities' abilities to respond to and recover from natural and man-made hazards.
The programme is being implemented by CDEMA in partnership with the Organization of Eastern Caribbean States (OECS).

The following countries have adopted the old 1996 CDERA Model legislation:
Anguilla, Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Montserrat, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Virgin islands (UK)

The new 2010 Model legislation has been developed to replace the older 1996 Model.
The following countries are going to adopt the new model.
Dominica, Turks and Caicos islands, Virgin Islands (UK)

3.7.8 Major NT Members

The key NT members of each pilot state which will appear on Memorandum of Understanding are shown in the following table. MOU states that the leading disaster management office will positively consider adding a new organization or an entity to the system.

Table 3-26 Key NT Members in each pilot state

Pilot State	Key NT members
Belize	National Emergency Management Organization (NEMO) National Meteorological Service (Met Service) Land Information Center, Land and Surveys Department National Association of Village Council (NAVCO) Crooked Tree Community Belize Red Cross Society (BRC) Belize Telemedia Limited (DIGICELL)

Pilot State	Key NT members
Dominica	Office of Disaster Management (ODM) Dominica Meteorological Services (Met Services) Dominica Lands and Surveys Division (Lands & surveys) Bath Estate Community Dominica Red Cross Society (DRC) LIME/DIGICEL
Grenada	National Disaster Management Agency (NaDMA) National Water and Sewerage Agency (NAWASA) Grenada Land Use, Ministry of Agriculture (Land Use) Physical Planning Ministry of Works Balthazar Village Grenada Red Cross Society (GRC) DIGICEL
Guyana	Civil Defence Commission (CDC) Hydrometeorological Service (Hydro-Met) Guyana Lands and Surveys Commission (Lands & Surveys) Upper Mahaica Community Guyana Red Cross Society (GRC) Guyana Telephone and Telegraph Company (GT&T)
Saint Lucia	National Emergency Management Organization (NEMO) Saint Lucia Meteorological Services (Met Service) Survey and mapping Section, Ministry of Planning (Survey & Mapping) Corinth Community Saint Lucia Red Cross Society (SLRC) DIGICEL Saint Lucia Limited (DIGICEL)

3.8 Sustainability Plan

A sustainability plan for CADM was prepared in Phase 1. The concept of the original plan was positive and covers wide area. However the contents shall be adjusted according to the realities of the actual circumstances.

In the Phase 2, in order to initiate constructive discussion and to assist the Caribbean side, the JICA Team prepared a Draft Sustainability Plan for Flood Disaster Management in CDEMA participating States during the second year period.

At the Annual Seminar on March 15, 2011, initial discussion was held over the draft plan. The draft plan indicated approximate annual budget as in U.S. Dollars 300,000.00. This amount is far less than that of indicated in Phase 1. Nevertheless, it still requires further financial considerations.

Under such circumstances, the Caribbean side proposed to have a platform for discussion on the Sustainability Plan in order to participate more enthusiastically.

A draft sustainability plan was discussed between RT members and JT members in the mid-term meeting held on August 30, 2011.
In the meeting, the following comments and suggestion to the plan were raised:

Basic structure
The basic structure components of the plan should be as follows:

Technical Aspect including Equipment	Financial Aspect	Human Resources Aspect including Training
Communication Aspect including Dissemination and Collaboration	Institutional Aspect including Policy and Legislation	

Others
- Role of RT members should be clearly mentioned.
- In the financial aspect, cost of volunteers should be included and the cost sharing by each organization should be mentioned.
- The plan should be made up in the mid-tem and the long-term plan.
- Resources mobilization should be emphasized.
- JICA support should be taken into consideration.

After the meeting, the draft plan was revised by the JICA experts and members of RT based on the comments and suggestion in the meeting.

The revised draft plan was discussed with Dr. Opadeyi and JT member on May 30, 2012 and substantial part was again revised based on the discussion. The substantial part of the draft Sustainability Plan is as follows:

The essential parts of the sustainability plan are 1) community-based disaster management plan, FEWS and FHM. The community-based disaster management plan doesn't have any level but FEWS and FHM have 3 levels, namely High, Moderate and Non-TI levels and all CDEMA participating states should select the levels in consideration of the own technical level, the human resources level, the financial level and the institutional level. This may lead to the sustainability of the disaster

management activities of all states.

The revised draft plan was again discussed and finalized during the annual seminar and the JCC meeting on June 5 and 6, 2012.

The outline of the sustainability plan thus finalized is as follows:

Definition

- Sustainability is the long time responsibility in the flood disaster management for the present and future generations in the CDEMA participating states.

Objectives

- To expand the activities to promote and deliver CBDMP, FEWS, and FHM to flood vulnerable communities other than the pilot communities in CADM2 Projects and in other CDEMA Participating States.

Framework

- Among CBDMP, FEWS and FHM, a state should undertake a process to establish CBDMP because CBDMP has utmost importance among the three components of the CADM2 by directly affecting the security of the people and their property. A state then should establish FEWS to incorporate into CBDMP to improve the efficiency of the existing CBDMP and FEWS. Establishing FHM follow FEWS.
- Sustainability plan should consider the components of 1) technical capacity, 2) human resources capacity, 3) institutional capacity, and 4) funding capacity.

Sustainability Plan

- A state, in implementing the similar nature project, should consider the levels of the above-mentioned components of the state, and should select the appropriated level raised in the levels in the Sustainability Plan.
- The roles of related agencies are also clearly mentioned and the needed costs of implementing the sustainability plan are prepared in the sustainability plan.

The finalized Sustainability Plan is included in this Report as Attachment-2.

4. EFFORTS AND LESSONS LEARNT

Following are the major efforts made for effective project implementation and for self-sustainability and enhancement of the project effect and learnt from them:

(1) Collaborative with RT

Through the project implementation, the JICA experts collaborate with the members of RT, that is, for the activities of FHM, FEWS and hydrological database with CIMH, for CBDRM with UG and for the disaster management with UWI. All of the organizations of RT have educational function. Therefore, the project activities will contribute to the disaster management of the pilot sites, but also human resource development for the disaster management in the Caribbean region.

(2) Collaboration Works with CIMH Specialists:

Office of JICA Experts for Flood Analysis, FHM and Hydrological Database/GIS was prepared in the campus of CIMH. The CIMH is an institute for training and research to improve the meteorological and hydrological services of the member countries of CMO (Caribbean Meteorological Organization). This arrangement was effective to implement project works effectively with CIMH Specialists in close contact as follows.

- Regular technical meetings and other occasional meetings with CIMH Specialists enable to make free discussions and collaborative works for flood analysis and early flood warning.
- Results of the collaborative works would be extended to the CMO countries by the CIMH Experts and contribute to promotion of activities for flood analysis, early flood warning. flood hazard mapping and hydrological database and GIS

(3) Selection of Practical Software for Analysis:

Following software was selected for the flood analysis after discussions with CIMH Specialists considering basin characteristics and usefulness of the software.

- Runoff Analysis: HEC-HMS developed by US Army Corps of Engineers was selected, since HEC-HMS has enough function to the analysis and everybody can download the latest one with user's manuals from internet at no charge. It is already used widely in Caribbean countries.
- Flood Flow Analysis: HEC-RAS developed also by US Army Corps of Engineers was selected. HEC-RAS is applicable to the analysis of one-dimensional flow such as those in island river basins which has no large-scale flood-prone areas. Everybody can download the latest one with user's manuals from internet at no charge. For flood flow analysis with large-scale flood-prone areas, FLO-2D is to be used.

(4) Application of Different Approaches Depending on Basin Characteristics and Availability of Data:

The pilot river basins distribute over 5 countries, and the basin characteristics and availability of data are also different. In consideration of these, following approach to the analyses were taken.

- Roseau River in Dominica and Bois d'Orange River in Saint Lucia: These rivers are located in islands, and have small basins and steep river slopes. The large-scale (1/2500) topographic maps are available for these rivers. Flood flows of these rivers were analyzed by HEC-RAS based on flood runoff estimated by HEC-HMS, since the flooding areas were limited to relatively narrow areas along the river course. River sections for flood flow analysis were prepared synthesizing the surveyed river sections and riverbank sections estimated from the large-scale topographic maps.
- Great River in Grenada: Characteristics of river and method of flood flow analysis were same in principle as the island rivers mentioned above. However since large-scale topographic map is not available for this river, 1/50000 topographic maps were referred to

assume extend riverbank sections.

- Belize River Valley in Belize and Mahaica River in Guyana: These rivers are located in continental lands, and have relatively large basins with very gentle slopes. Inundation areas of these rivers are extensive and inundation periods are long (more than one month). Large-scale topographic maps and elevation data applicable to flood flow analysis are not available. However, the changes of flood water levels are so gradual that people could take actions observing the flood water. Flood flow simulations by analytical procedures would not always be necessary. In due consideration of these, characteristics of floods for early flood warning were studied based on the water level records available for the basins.

(5) Sharing of Roles between NT and RT

NT of respective countries are establishing early flood warning system sharing the roles with RT. It is practical and effective to share the roles, since it is difficult for respective countries to own every human resources and technology by themselves. With this approach, steady collaboration between NT and RT is crucial to keep self-sustainability. Keeping these in mind, considerations were made on the following during the services.

- Discussions were made with CIMH/RT specialists not only on the software operations but also on the modeling methods of flood runoffs and flood flows and data processing to prepare input data, so that they could assist NT in collecting appropriate basin data and flood information.
- In the meeting with NT, explanations were made how the hydrological data and flood information collected by NT were used in flood analysis. All outputs of the analysis were submitted to respective NT together with appurtenant data, which includes results of river survey, flood surveys and flood analysis made so far.
- During the mission to pilot countries, CIMH/RT Specialists intended to inspect actual situations of river basins and flood disasters, and to keep close relationship with NT and other persons concerned.

(6) GIS/FHM Training based on know-how of CIMH considering countries' needs

CIMH is a CARICOM research institution specialized in operational meteorology and hydrology as well as a regional training center to enhance administrative service in this field, with know-how on human resource development and wealth of experienced faculties and instructors. Accordingly, the project approach to aim capacity enhancement in the Caribbean region through CIMH, is efficient and effective to achieve the project goals.

In recent years, however, the applicants for training courses have been decreasing. Especially in hydrological section, the scheduled training courses tend to be canceled or joined with a course of meteorology due to fewer applicants. This may be because there is no practical roadmap to utilize hydrological issues into the administrative services unlike meteorology that has high expectation on such as aviation weather and weather forecasting.

In the project, therefore, a short-term training course on GIS/FHM as well as hydrological database was held in CIMH considering countries' needs on GIS and FHM, with help of the know-how of CIMH on human resource development.

The project purchased 16 licenses of GIS software and installed into the CIMH's training room, so that all participants can conduct practical training using each computer. Prior to the training course, master-trainer's training intended for CIMH faculties were also conducted. The training materials for master-trainers were also utilized for the GIS/FHM course to the countries. Trainings were efficiently conducted by such step-by-step approach.

Due to the high trainer's capacity of CIMH faculties with strong incentives of participants, the training course was highly appreciated by participants.

(7) Design of hydrological database concordant with CIMH's strategies

Several countries have already been managed web-based hydro-meteorological database system. Thus it was required for establishment of a new database in CIMH to consider the existing

countries' database system as well as data quality and format. Further the CIMH's framework on sustainable management strategy on hydro-meteorological network is also considerable issue for the future sustainability of data management.

As a result of discussion with CIMH and JICA team, basically the hydrological database has to be managed and updated by each county, is automatically updated into CIMH server system. Accordingly the data updating can be reasonably done by countries and necessary information will be accumulated in CIMH. In this project, therefore, a central server in CIMH, national level database in Guyana (NWIS) and internet linkages between CIMH and counties' databases were developed. As to the countries where no web-database has been managed, we required to send necessary data through web or any formats to CIMH.

(8) Practical training to promote utilization of hydrological data

For sustainable management and updating of hydrological data, it is essential for administrative agency to gain understanding on concrete application of hydrological data for disaster risk reduction. Most of hydro-meteorological agencies in the counties have rich knowledge about weather forecasting and agricultural meteorology, but they have less opportunity of the effective use of hydrological data such as designing and construction of river structures.

In view of this circumstance, the training course of GIS/FHM involved a short lecture on rainfall data collection, probability precipitation and rainfall intensity curve within the lecture of GIS and hazard mapping. Such technical knowledge on precipitation is very important to prepare hazard map by each counties.

(9) Dissemination and web training on hydrological database

A faculty of CIMH has accompanied with JICA expert whenever visiting to agencies in each country for explanation and dissemination of hydrological database. Since there are a number of graduated students who learned in CIMH in each agency, the project activities can be easily understood by them, and the meetings and site visiting were effectively arranged. This is attributed by CIMH's actual performance and confidence as a training institution in Caribbean region.

On the other hand, the training on national level database (NWIS) in Guyana has been conducted by use of remote desktop function via internet in attendance of the system developer, CIMH staff, JICA expert and staff of Guyana Hydro-Meteorological Service. Since it was not necessary for JICA export and the other attendances to be on-site, the training was flexibly conducted when convenient for every attendance.

(10) Institutionalization of NT System

Attention and enthusiasm of NT to the project are strongly linked to the progress of each project component during the project. Accordingly the good progress in each project component is fundamental for institutionalization of NT members Besides, it is very important to show the merits of CDMP, FEWS and FHM

5. RECOMMENDATIONS AND SUGGESTIONS

Recommendations and suggestions based on implementation of the Project are as follows:

(1) Disaster Management

During the implementation of activities of CADM2, some cases have been found that the cause of the flooding in the target communities is just a structural issue. It seemed to be desirable to eliminate the structural issue rather than applying the non-structural approach that is the basic approach of CADM2. The overall goal of the project is to mitigate the flood disaster. Accordingly it should be taken into consideration for the project design to consider the possibility of applying the structural approach, or the selection of target community should be conducted where the non-structural approach is the only one method to mitigate the flood disaster for the community.

(2) Sustainability of the Project

- In the sustainability plan of the project, it is recommended that the community-based disaster management activities should be conducted in the order of CBDMP, FEWS and FHM. After CADM2 project, when the similar type of project is going to be conducted, it is strongly recommended that the above-mentioned activities of CBDMP, FEWS and FHM be conducted in the said priority. If FEWS is established first before CBDMP for example, the effectiveness of FEWS will be limited very much since the community people don't know what to do and how to do even though they receive the flood warning.
- NT is encouraged to promote awareness of community in disaster management.
- NT is encouraged to foster the hydrologist and the CBDRM experts in cooperation with the organizations of Civil Society.
- NT is encouraged to cooperate with the telecommunication network providers in disaster management.
- It is encouraged that MOU among the organizations be prepared before implementation of the similar project of CADM2, in order to clarify the responsibility and roles of the organizations for the project implementation.
- CDEMA is encouraged to monitor the progress of activities of the Sustainability Plan of the Project. To follow the Sustainability Plan, expert of monitoring is one of the ideas to secure the sustainability.
- RT is encouraged to make an effort to enhance the activities of education and training in the field of disaster management activities.

(3) Arrangement of Donors

- CDEMA is encouraged to coordinate the development donors such as UNDP, USAID, CIDA, AUSAID, and the others to avoid the overlap activities by the donors.

(4) Collection of Hydrological Data

- CIMH has launched Climate Data Rescue Project funded by Caribbean Development Bank (CDB) to rescue any formatted old hydro-meteorological data stored in countries. Though the hydrological data is only a small part among the climate data that the Rescue Project targets on, it is highly expected that the data can be effectively collected by such CIMH's effort in future. The collected hydrological data can be used for not only hazard map and flood disaster mitigation measures but also designing of river structure and bridges as well. It is recommended that CIMH and hydro-meteorological agencies in countries provide administrative services such as analyzed rainfall intensity curves in terms of full utilization of hydrological data into the public works.

(5) Implementation of Flood Survey

- It is advised that actual flood situation be surveyed just after the big flood and compiled as a flood report. The flood report should include meteorological, topographic and social causes of flood disaster and mechanism of damage occurrence together with flood maps showing distribution of inundated areas and damaged sites. The flood map can be used as a flood hazard map by itself, and flood mechanism suggests the flood prevention measures required.

(6) Preparation of Map

- Large scale topographic map (1/2500 or more) is inevitably required for flood flow analysis and to present its result. Large scale map is desired to be collected for flood analysis from other offices, if it is available. If not, it is recommended to prepare the map. Once the map is prepared, it can be used not only for the analysis but also for other purposes like land use and town planning, etc.