The People's Republic of Bangladesh

The People's Republic of Bangladesh Data Collection Survey on Early Warning and Disaster Information System in Costal Area

FINAL REPORT

July 2013

Japan International Cooperation Agency (JICA)

Earth System Science Co., LTD. (ESS)
Japan Telecommunications Engineering and
Consulting Service (JTEC)

Study Area

Summary

I. Background and Objectives of Survey

Natural disasters such as floods and cyclones hit the People's Republic of Bangladesh (hereinafter "Bangladesh") every year, and the annual economic loss from these disasters accounts to about 600 million yen (equivalent to about 6.49 million US dollars as of Feb. 2013). Damage from cyclones which occur in the Indian Ocean is relatively huge. The cyclone of 1970 caused the worst damage, and more than 300 thousand people lost their lives. Even though the number of victims has been decreasing, more than a thousand people lost their lives from Cyclone Sidr (November 2007).

In the Sixth Five Year Plan 2011-2015, disaster risk management is considered as one of the focal areas. The economic loss from disasters from 1990 to 2008 amounts to 2,189 million US dollars (1.8% of Gross Domestic Product (GDP)). The government of Bangladesh (GoB) plans to increase the budget for disaster risk management to twice as much than that of the past in the period of 2011-2015.

At the legislative level, amendments of the National Plan for Disaster Management and the Standing Order on Disaster (SOD) were formulated in 2010. In September 2012, the Disaster Management Act was enforced, and the Ministry of Food and Disaster Management was divided into the Ministry of Food and the Ministry of Disaster Management and Relief. The Department of Disaster Management was newly established. The government plans to formulate the National Disaster Management Policy in 2013.

Because of the intensive development of legislation, the implementation system is facing challenges. Multiple organizations are involved with the disaster information system (for example, organizations for climate and hydrological observations, decision making organizations for early warning and organizations for disaster information transfer to the local governments and community people). Their functions are overlapping, and a communication system among the organizations needs to be developed. Another problem is the speed of disaster information transfer. There is also a problem with community people, who are the receivers of disaster warnings.

Japan implemented some projects such as capacity development for climate observation analysis and assisted construction of cyclone shelters. However, Japanese assistance to Bangladesh mainly focused on capacity enhancement on announcement of warnings and construction of cyclone shelters. Therefore, Japan does not have adequate information on the disaster information system, early warning and community people who are the receivers of disaster warnings. This information needs to be collected to consider the validity of Japanese

assistance and middle and long term assistance scenarios.

II. Current Status of Organizations related to Early Warning and Disaster Information System

1.1 Department of Disaster Management (DDM)

(1) Manpower of Staffs

In Department of Disaster Management (DDM), there are several staffs in charge of disaster risk management including District Relief and Rehabilitation Officer (DRRO) and DMIC in District level. However, in Upazila level, there are two (2) staffs of Project Implementation Officer (PIO) and Office Assistant. Below Union level, there is no staff for disaster risk management[1]. In terms of training, few training and seminar have been held, therefore capacity development for not only early warning and disaster information system but also all over disaster risk management is required.

(2) Insufficient Budget

Most of Districts have only 100,000-200,000 BDT for disaster relief fund and around 50 tons of rice as stock for disasters. The budget for training is not ensured in most cases.

(3) Difference of Activities depending on Years of CPPs Established

Activities of DMC/DMIC are different from area to area. In areas CPP established in 1970's, activities of CPPs are mostly very active, on the other hand, activities of DMC/DMIC are not so active in these areas. Of course, there are some areas where CPPs and DMCs/DMICs are in good collaboration, but they are only in limited areas. CPPs which were established recently have not had enough experience with activities of disaster risk management. Therefore, activities of DMCs/DMICs are more active compared to CPP's. It is noted that CPP members are eager to fulfill their tasks even they do not have adequate experience, equipment and offices.

(4) List of Cyclone Shelters

Comprehensive Disaster Management Program (CDMP) has been preparing a database of cyclone shelters and location maps. However in this database, there are some lacks of cyclone shelter data. Preparation/update of database of whole cyclone vulnerable areas is one of the

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[1] The largest administrative unit of Bangladesh is Division. Division is followed by District/Zila, Upazila, Union and Unit. As outside of the administrative unit, City Corporation (CC) and Pourashava (PS) are assigned in some areas.

most important issues to be handled.   Based on the data, to prepare a master plan for cyclone shelters and evacuation plans are one of the highest priorities.

1.2 Bangladesh Meteorological Department (BMD)

(1) Inaccuracy of Forecasting

Under the same signal, the weather condition differs area to area.   Sometimes it happens that it is quite sunny under signal 10.   On the contrary, a whole island can be inundated under signal 4 unfortunately.   Setting up of signals in small scale is needed.   However, capacity development of forecasting and development of weather observation stations are essential

(2) Use of Water Level Information

In the case that the whole island was inundated under signal 4, warnings were not issued because water level information could not be obtained.   The SOD does not mention about water level information.   Moreover, information which should be provided from BMD does not include water level information.   The information is strongly recommended to be added.

(3) Improvement of Reliability by establishing Information Transmission System

Signal is disseminated only when the signal goes up.   Therefore, community people do not know the actual situation, and they get confused.   Development of appropriate information transmission system is recommended.

1.3 Bangladesh Water Development Board (BWDB)

128 water level observation stations operated by the Bangladesh Water Development Board (BWDB) have been installed in the estuarine basin.   Cyclone disasters are related to storm surge, therefore water level information is quite important for the cyclone early warning system. However, the information is not shared with other related organizations.   According to the SOD, it says "provide flood early warning", but regarding water level, it only says "observe water level".   Therefore, the SOD is recommended to be revised.

III. Activities during Cyclone Mahasen

1. Damages by Cyclone Mahasen

17 people died of the cyclone.   Among them, seven (7) died in Barguna, four (4) in Bhola, three (3)in Patuakhali , one (1) in Pirojpur and two(2) in Chittagong.   More than 1,000,000 people were affected by the cyclone.

2. Information Transfer Situation to Each Organ Concerned with Cyclone Mahasen

When Cyclone Mahasen hit, the survey team was staying at Chittagong and the Cox's Bazar District.   Cyclone information of District, Upazila, Union, and the radio stations was

collected.   The DDM line[2] delayed from the Cyclone Preparedness Programme (CPP) line[3] due to internal processing.   If bulletins are updated during outside of the business hour, the delivered information is kept overnight without updating.

The average was two (2) hours 15 minutes for CPP and Six (6) hours one (1) minute for DDM from the issue of a bulletin to issue of warning at Uinon level.   The reason why the information transfer time was longer through the DDM line is shown below.

- It took a long time for internal processing in DDM headquartered (HQ).
- It sometimes took a long time for internal processing in local governments.
- It was impossible to handle bulletins out of working hour from Storm Warning Centre (SWC).

IV. Current Situation of Early Warning and Disaster Information System

1. Early Warning from Department of Disaster Management (DDM) Line

(1) DDM Line

In the DDM line, a land line can be used, and they can communicate through land line, fax, e-mail and mobile phones.   However below Upazila level, there are almost no land lines, so they mainly use mobile phones for communication.   An issue is that the information is delayed for 2-3 hours than CPP to Upazila level due to time for getting permission of delivering information in each level.

(2) Megaphone- Siren System

DDM is now installing a Megaphone- Siren System assisted by the World Bank.   At the moment, installation of the system has already been completed, but has not started to operate them because of lack of operators, necessity of repair and no connection to the power at remote stations.

2. Early Warning from CPP Line

In CPP line, HF wireless is used between HQ and Zones, Upazilas simultaneously.   VHF is used between Upazilas and Unions.   Mobile phones are used for communication between Unions and Unit leaders.   Unit leaders call CPP volunteers and they disseminate the information usually using bicycles and on foot.   Figure 1 shows information system of CPP.

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[2] DDM line: Early warning and disaster information dissemination route by the government, mainly from DDM

[3] CPP line: Early warning and disaster information dissemination route by CPP.

Table 1   Information System of CPP

Office			Communication tools	Signal		Language
				4-7	8-10	
HQ	⇔	Zone, Upazila	HF wireless system	-	-	English (Full information)
Upazila	⇔	Union	VHF wireless system	-	-	Bengali (Simplified information)
Union	⇔	Unit Leader	Mobile phone	-	-	Bengali
Unit Leader	⇔	Volunteers	Mobile phone(mainly)	-	-	Bengali
Volunteers	⇔	Community	Face to face By walk, motorcycle, Bicycle	Mosque microphone, Megaphone, etc.	Siren, Megaphone	Bengali/ Local Language

Source: JICA Survey Team

The number of equipment is inadequate in both CPPs which were established in the 1970's and which were newly established.   Some equipment which is procured recently breakdowns within a year, and the problem on scarcity of equipment is still existing.

3. Information Dissemination Ratio/ Evacuation Ratio

Major issues are as follows:

(1) Issues in CPP

CPPs established after Cyclone Aila (May 2009) tend to less active than others.   They do not have adequate experience.   Therefore, the information dissemination ratio tends to be lower.

(2) Issues in Char Area (Island area which is created by accumulation of sediments)

No CPPs are assigned in Char Areas.   Therefore, the areas are out of the information network.   The areas also have problems with road network and other infrastructures. Therefore, it takes longer time for information dissemination or there is lack of information.

(3) Isolated Areas

It takes time for information dissemination due to the distance.   In addition to it, road network and other infrastructures are under development.   Due to the reasons, the information dissemination ratio is lower.

(4) Early Warning to Fishermen

Out of these fishing places, it is very difficult to disseminate early warning to fishing boats that go to deep-sea area 50-200km far away from coast.   Even if fishermen have mobile phones and radios, it is impossible to communicate from deep-sea because the signal areas is very limited.   25% of deaths were fishermen during Cyclone Aila (May, 2009). They could not be communicated in deep-sea, and then they were hit directly by the cyclone. According to CPP HQ, they disseminated early warning information earlier than before to fishermen, and there were no deaths during Cyclone Mahasen (May 2013).   It is necessary to consider an effective early warning system for fishermen.   At the moment some of CPPs have a plan to install light houses for early warning.

(5) Setting of Adequate Lead Time and Shortening of Information Dissemination Time

The information dissemination ratio has a direct relation with lead time for early warning. With enough lead time, the information dissemination ratio should rise, but without enough lead time, the ratio will probably fall.

In the SOD, the lead time of "Great Danger" is At least 10 hours before.   However, as per during Cyclone Aila (May 2009), the warning level was suddenly changed during the night time, and it was impossible to obtain 10-hour lead time.   Therefore, it is realistic to consider a system to disseminate warnings to community people as soon as possible.

(6) Evacuation Ratio

Evacuation ratios vary in urban areas and rural areas.   In urban areas, there are many concrete buildings and they are used as cyclone centers in disaster times.   Also people want to evacuate to more comfortable places such as their relative's and friend's houses than cyclone shelters.   Actually, people who need to evacuate are mainly living along rivers and in farming villages where there are no concrete buildings.

For example, during Cyclone Aila (May 2009), people evacuated earlier based on the experience of Cyclone Sidr (November 2007).   Also during Cyclone Mahasen (May 2013), CPP reported that the evacuation ratio was more than 80 % in some of the survey areas.

4. Emergency Relief Information

Mobile phones are mainly used for communication to request of emergency relief.   The information flow begins with Union Parisad (UP Chairman) to Upazila Nirbahi Officer (UNO).

At the same time, an emergency situation report and application for request of emergency relief materials are prepared.   However, there is no fax in Union level, therefore the UP Chairman sends them to UNO by mail.

There used to be an HF wireless system from DDM HQ up to Upazila level before 2008,

but at the moment, this system is not working. Therefore, at the moment mobile phones are the only communication tool for emergency relief information. Mobile phones are vulnerable during and after disasters. Therefore, ensuring a supplemental system is essential.

5. Issues of Early Warning and Disaster Information System

(1) Current Status of Early Warning and Disaster Information System

There are several lines of early warning dissemination in Bangladesh such as DDM line (a line through DDM, DMIC and DMC (from the central government to the local government)), early warning dissemination through CPP (from CPP HQ to CPPs at local level using in early warning system) and media such as TV and radio. At the moment the CPP line has played the main role in the early warning system.

A conceptual diagram of early warning information flow in Bangladesh is shown in the figure below.
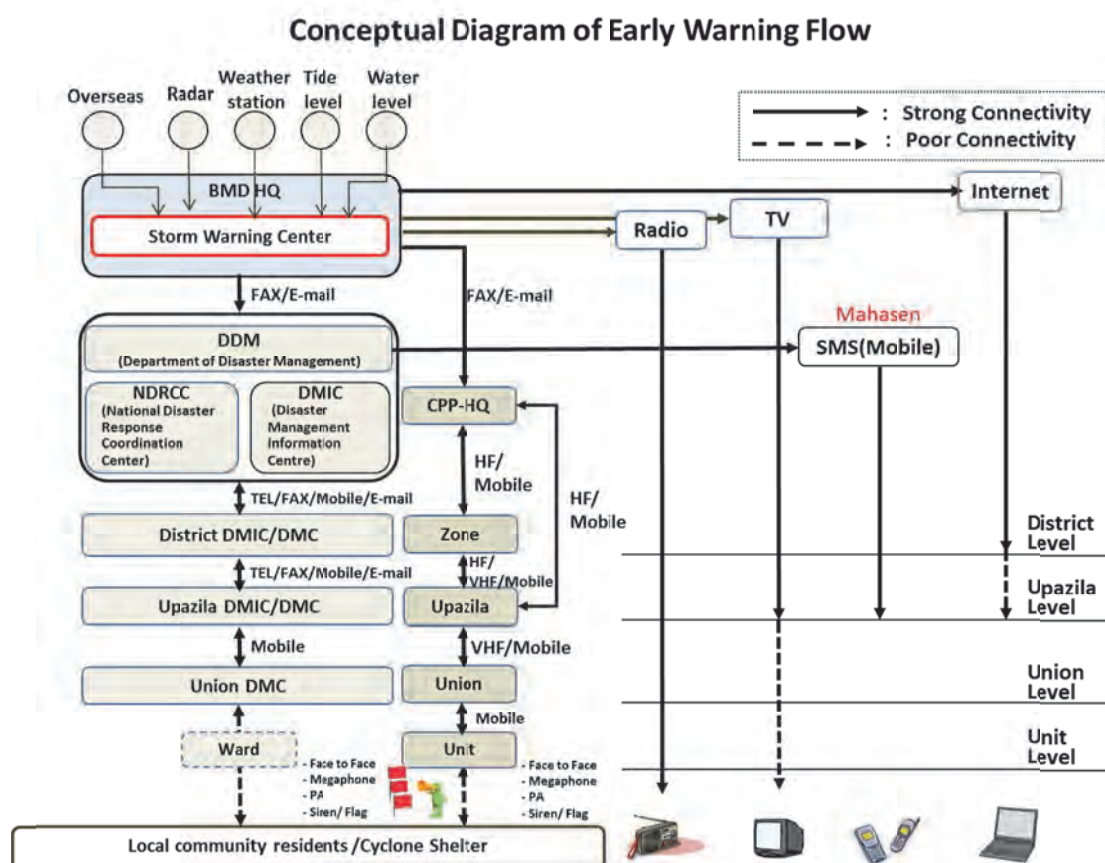
Source: JICA Survey Team

Figure 1   Conceptual Diagram of Early Warning Flow

(2) Issues of Early Warning and Disaster Information System

The following four (4) concepts are very important for proper work of early warning and evacuation at early stage safely.

[Rapidity]: early warning is disseminated to community people as soon as possible

[Accuracy]: improvement of accuracy is needed

[Dissemination]: information is disseminated even under network problem during disasters

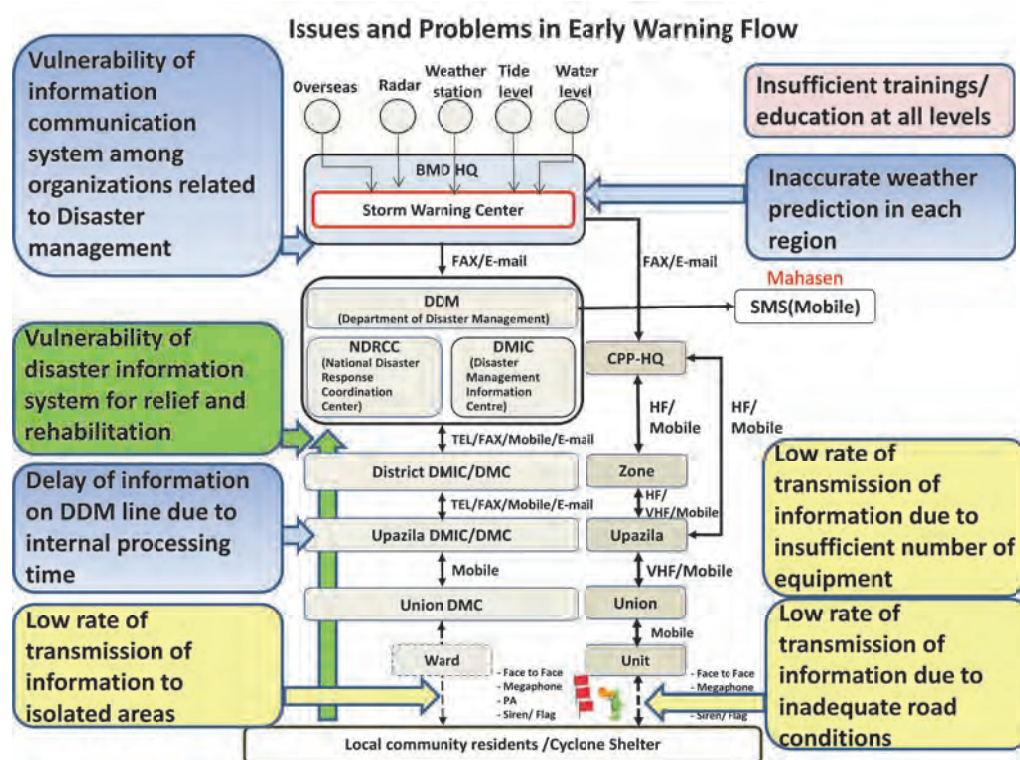[Persuasive]: disseminated information is persuasive enough to evacuate

Figure 2   Issues and Problems in Early Warning Flow

(3) Possible Countermeasures for Issues of Disaster Information System

A remote control speaker-siren system which uses Remote Amplifier Activation via AM/FM broadcasting radio by using Dual Tone Multi-Frequency (DTMF) is effective.

Another proposal is mobile speakers to supplement the speaker-siren system.   This equipment has two (2) speakers that are set on a motorbike, vehicle, bicycle, rikishaw etc. in order to disseminate warnings to wider areas.

V. Major Problems with Cyclone Shelters

1. Lack of Capacity of Cyclone Shelters

The number of cyclone shelters is insufficient in all target areas at present, and the capacity

of cyclone shelters is less than 10% of the total population.　Meanwhile, concrete buildings are common in urban areas, and the situation is completely different to that of rural areas.　Scarcity of cyclone shelters in rural and isolated areas is severe.

2. Inadequate Facilities

Facilities such as toilet, power, drinking water are communication means are inadequate or some cyclone shelters do not have these necessary facilities.　A cyclone Shelter was constructed by Swiss Agency for Development and Cooperation (SDC) in 2012, and the cyclone shelter is fully equipped.

3. Lack of Stock of Food and Drinking Water

Most of cyclone shelters do not stock food and drinking water.　Some communities asked people to bring their food when they evacuate.

4. Inadequate Access Road

Development of access roads to cyclone shelters is inadequate, and it is difficult to evacuate to cyclone shelters especially under heavy rains.　The condition may be affecting the evacuation percentage.

5. Operation and Maintenance

Most cyclone shelters are ordinarily used for schools, and then the School Management Committee (SMC) maintains them.　However, there is no budget for operation and maintenance, and therefore, it affects the proper operation and maintenance of cyclone shelters.

CDMP is developing databases and maps of cyclone shelters.　However, all information of cyclone shelters is not necessarily contained in the database. It is necessary to make a cyclone shelter database covering all cyclone shelters in cyclone-prone areas and to update the data. And furthermore, it is needed to distinguish the areas where there are no or insufficient cyclone shelters, which is a highest priority work.

VI. Other Issues related to Disaster Risk Management

1. Community Based Disaster Risk Management (CBDRM)

(1) Awareness

The level of awareness is getting higher due to repeated cyclones.　However, many community people wait until the last minute to evacuate.　They eventually evacuate to house tops or tree tops since they do not have enough time to evacuate to safe places.　A focus should be given to how and when they should evacuate to other areas sagely to improve the situation.

(2) Education and Exercises

Levels of education and exercise are not adequate.　About half of the respondents of the community questionnaire survey responded there was no evacuation drill.　Capacity development is needed.

(3) Education, Exercises and Awareness Raising of Fishermen

Fishermen tend to go offshore even a warning is issued to catch fish, or they do not come back to safe areas even they know a cyclone is approaching.　Awareness raising through education and exercise is to be one of the major challenges.

(4) Rehabilitation and Reconstruction after Disasters

Rehabilitation and reconstruction operations after disasters are not progressed due to lack of budget.　As an example, polders were completely destroyed by Cyclone Aila (May 2009) in some areas.　Some of the areas are inundated even now because of no operations are taken. In those areas, people had to reconstruct their houses on or near destroyed polders, and the communities became like slums for two (2) years.　If adequate structural measures are taken, rehabilitation and reconstruction processes can be progressed smoothly.

Implementation of structural measures and development of a system which focuses on rehabilitation and reconstruction process are essential to reduce a burden during rehabilitation and reconstruction processes.

(5) Problems at Community Level and Suggestions to CBDRM

The problem that exists in the receivers' side is they wait until the last minute to evacuate, and when they make the decision to evacuate, the level of inundation is too high, and it leads to a high percentage of casualties.

The important items to improve the current situation are development of an environment in which people can evacuate without any worries and an opportunity to receive disaster risk management education to acquire appropriate knowledge.　Development of a disaster risk management plan at community level is also important to clarify the role of each actor in both normal occasions and emergency times.　It is recommended to conduct evacuation drills based on the plan along with multiple possible scenarios.　Development of a daily maintenance system and a management manual during disasters is essential.　Exercises on management of cyclone shelters are very important as well.　Implementation of structural measures and development of a system which focuses on rehabilitation and reconstruction processes are essential to create disaster resilient communities.

2. Warning Level in SOD

(1) Signal

A 10-level warning has been adopted in the SOD.　A new warning method which using 6 levels is also mentioned in the SOD, but the implementation is practically impossible at this moment because CPP does not recognize the advantage to use the new warning level, and also community people will misread the warning level and will not evacuate although they have to. The current warning level is suitable.

(2) Other Issues

The SOD clearly mentions roles and responsibilities of disaster risk management related organizations.　There are some problems with frequency of meetings, implementation of evacuation drills and lack of emergency correspondence plan and other plans

3. Erosion

Structural measures are effective.　However, there is a problem with maintenance of polders.　They are left broken for a long time.　In areas where the speed of erosion is high, the speed of construction work of a polder and the speed of erosion is about the same.　An attention should be paid to the fact that the erosion occurs as a part of passage change at the mouth of the Megna River.

4. Ensuring Transportation means

There is severe scarcity of transportation means for rescue activities such as boats and motorbikes.　The demand for boat is high since it can be helpful to rescue a large number of people.　Motorbike is effective tool for early warning dissemination.

VII. Possible Assistance Scenario by JICA

(1) Issues related to early warning and disaster information system

Issues related to early warning and disaster information system are "Early warning/ disaster information system", "Capacity enhancement for early warning/ disaster information system", "Cyclone shelters", "CBDRM", "Revision of the SOD" and "Transportation means".

Erosion is also important, but middle and long term assistance is needed.　Regarding construction of cyclone shelters, other donors work on this area and therefore the highest priority is not given to the area.　However, the evaluation of Japanese technology is high, and demand for Japanese assistance is high.　The highest priority is given to cyclone shelters, but formulation of a development plan may be needed among the donors before implementation of assistance.

Ideally the revision of the SOD is done by MoDMR and DDM, but some parts of the SOD do not match the current situation of implementation organizations. Coordination with organizations related to disaster risk management such as BMD, BWDB and Public Works Department is essential. It is also important to collect and analyze data from the related organizations and develop practical policies and disaster risk management plans.

2. Assistance scenario

Based on the evaluation made in the above section, high priority is given to three (3) categories, and they are "(1) Improvement of Conditions surrounding Cyclone Shelters including Evacuation Routes", "(2) Early Warning and Disaster Information System" and "(3) Capacity Enhancement for Early Warning and Disaster Information System.

(1) Improvement of Conditions Surrounding Cyclone Shelters including Evacuation Routes

Based on the result of the survey, the capacity of cyclone shelters is only 10-20 % of the population ratio (this data only focuses on cyclone shelters, and concrete buildings which can be used as evacuation sites are not considered. However, there are few concrete buildings in case of rural areas, and therefore, it is reasonable to consider the rate to be about 20%).

That means around 80% of residents have no place to go in a disaster even after implementation of "(2) Early Warning and Disaster Information System" and ("3) Capacity Enhancement for Early Warning and Disaster Information System". Therefore, improvement of cyclone shelters is one of the most important issues to be considered.

Based on the interview survey, it takes around 30 minutes to cyclone shelters on average, the maximum is 3 hours.

When access roads become muddy by heavy rains, it could take more than 2-3 times than usual. The evacuation rate will decrease because it is difficult to evacuate under such road conditions.

Establishing model areas after selection of high-priority areas, conditions surrounding high priority cyclone shelters should be improved including evacuation routes.

Item to be included in the agenda are shown below.

- Improvement of Cyclone Shelters
  - Identify high priority areas of Cyclone Shelters
  - Construction of Cyclone Shelters
  - Repair of Cyclone Shelters
  - Improvement of facilities in Cyclone Shelters
- Improvement of road network around cyclone shelters

- Improvement of evacuation routes to high priority Cyclone Shelters

(2) Early Warning System and Disaster Information System

"(1) Early Warning and Disaster Information System is designed to enhance a system which disseminates disaster information before disasters hit based on analysis of related organizations such as BMD. It is desired that activities of each organization effectively work together until the reconstruction process. Especially, it takes a longer time to transmit warnings to isolated areas including Char Areas, the system should be able to transmit warnings within a certain lead time.

Some of the principal equipment is a "Remote control speaker-siren system" and in order to supplement the speaker-siren system, "Mobile speaker (speaker with Vehicle/ Motorbike/ Bicycle) is recommended. Also "Satellite Mobile Phone" is mainly for the disaster Information System.

Item to be included in the agenda are shown below.

- Counterpart and target organizations
  - DDM ⇔ District ⇔Upazila ⇔ Union
  - Organizations related to disaster risk management
- Equipment
  - Remote control speaker-siren system
  - Mobile speaker (speaker + Vehicle/ Motorbike)
  - Satellite Mobile Phones

(3) Capacity Development for Early Warning and Disaster Information System

"(3) Capacity Enhancement for Early Warning and Disaster Information System" is designed for community people to recognize warnings appropriately, and evacuate before disasters hit as well as capacity enhancement for early warning and disaster information systems among DMC, CPP and other related organizations.

Item to be included in the agenda are shown below.

- Awareness raising
  - Implementation of disaster risk management education at schools
  - Assistance for development of hazard map
  - Assistance for development of community disaster risk management plan
  - Assistance for evacuation plan
  - Implementation of evacuation drills
  - Capacity enhancement for appropriate operation and maintenance of cyclone shelters using the system which is to be installed
- Development of disaster risk management capacity of DMC/CPP

- ⁃ Training and evacuation drill led by DMC/CPP
- ⁃ Preparation of development plan of cyclone shelters
- ● Review of the SOD

Photos

Khulna District Koyra Upazila Dakshin Bedkashi Union : Union Office and major rural road still have been affected by Cyclone Aila (May 2009)

Satkhira District Shyamnagar Upazila Padma Pukur Union : Once it rains, unpaved road becomes muddy immediately.

Khulna District Koyra Upazila Dakshin Bedkashi Union : Ordinary rural community road

Khulna District Koyra Upazila Dakshin Bedkashi Union : Cyclone shelter and access road

Khulna District Koyra Upazila Dakshin Bedkashi Union : House constructed by a project funded by EU in Cyclone Aila (May 2009) affected communities

Khulna District Dacope Upazila Sutarkhali Union : Construction of cyclone resilient house

Khulna District Khulna City : Existing wireless communication system of Khulna District

Khulna District Khulna City : Covering area of medium wave by national radio

Khulna District Koyra Upazila : Alert dissemination system by flags

Khulna District Koyra Upazila Uttar Bedkashi Union : Mosque with loudspeaker

Khulna District Koyra Upazila Uttar Bedkashi Union : Cyclone alert dissemination on foot by CPP volunteers

Khulna District Koyra Upazila : Cyclone alert dissemination using van by Upazila staff

Patuakhali District Kalapala Upazila

Tiakhali Union：Unfunctional cyclone shelter constructed around 40 years ago. The building is currently used as an elementary school.

Patuakhali District Kalapala Upazila

Tiakhali Union : cyclone shelter constructed around 40 years ago. Zoom up of the photo on the left side. Concrete comes off and reinforcing bar can be seen.

Noakhali District Hatia Upazila

Nizhum Dwip Union : Cyclone shelter constructed by Japan's Grant Aid. The Union CPP office is located inside the shelter.

Noakhali District Subarna Char Upazila

Pobra Char Bata Union : Cyclone shelters constructed by Japan's Grant aid (left side) and by GOB (right side). The structure is completely different.

Noakhali District Hatia Upazila：

Water level meter installed and observed by BWDB. The meter is tilted by erosion.

Noakhali District Subarna Char Upazila：

Erosion along the Meghuna River. This area has been eroded 1km length from the river side in three years. Water comes 50cm to 1m lower the land surface at high tide.

Patuakhlai District Galachipa Upazila CPP Office : Emergency kit provided by Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ).	Patuakhlai District Galachipa Upazila CPP Office : A lot of megaphones in the office. Only 1-2 megaphones are working.
Patuakhali District DMIC : Equipment in the DMIC Office.	Patuakhali District Kalapala Upazila Tiakhali Union : Equipment installed by a project related to "Digital Bangladesh" it is well organized compared to other offices.
Patuakhali District Kalapala Upazila Tiakhali Union : The office of CPP Union Leader. This office is mainly used as his shop usually. VHF wireless is equipped.	Noakhali District Subarna Char Upazila CPP Office : Equipment of HF/VHF.

Patuakhlai District Galachipa Upazila

Amkhola Union : Houses out of polders. Floor beds are raised against flood/ storm surge.

Patuakhlai District Galachipa Upazila

Ratandi Taltali Union : Polder under reconstruction by BWDB. The polder was damaged by erosion.

Noakhali District Hatia Upazila

CPP Office : Radio provided by Japan in 1990's (left side) and it is still working. Left side is a radio made in China provided by CDMP recently, but it was broken in one year.

Patuakhali District Kalapara Upazila

Tiakhali Union : Killa.   The height became lower than before.

Luxmipur District Ramgati Upazila :

Eroded road. The road was eroded 1km length from the river side in three years. People were moving their houses to safer place.

Barguna District Amtali Upazila :

Broad casting equipment in the Community Radio in Amtali which is run by the government.

 Bagerhat District Sarankhola Upazila Randa Union: cyclone shelter constructed in 2012 by SDC. The cyclone shelter has sufficient equipment and facilities.	 Barguna District Barguna Sadar Upazila: Community Radio
 Cox's Bazar District: DMC meeting for Cyclone Mahasen (May 2013)	 Cox's Bazar District: Equipment of DMIC Office
 Cox's Bazar District: Radio Station	 Cox's Bazar_District: Radio Station Antenna for FM(Left) Antenna for AM(Right)

Barguna District Barguna Sadar Upazila Naltona Union: Government Primary school. This area does not have cyclone shelters.	Barguna District Barguna Sadar Upazila Naltona Union: Toilet and well in school Water is with high concentrations of salt and iron.

Cox's Bazar District Cox's Bazar Sadar Upazila : Evacuees in the shelter

Cox's Bazar District Cox's Bazar Sadar Upazila : CPP members are calling for evacuation	Cox's Bazar District Cox's Bazar Sadar Upazila : CPP/DMC members are calling for evacuation using CNG with megaphones.

Cox's Bazar District Cox's Bazar Sadar Upazila : Polices were collecting vehicles to get vehicles for refuge / relief	Cox's Bazar Moheshkhali Upazila Water overflows polder

Cox's Bazar District Cox's Bazar Upazila: Damaged houses by Cyclone Mahasen (May 2013)

Cox's Bazar Moheshkhali Upazila: Cyclone Shelter collapsed by Cyclone Mahasen (May 2013). Left: Before collapsed Right: After collapsed

Meeting with DDM	Meeting in CPP Headquarters
Bangladesh Meteorological Department （BMD）	Barguna District Barguna Upazila: Move to a small island by small boat
Barguna District Barguna Upazila : Interview survey to community people. Woman who gave birth on the day of Sidr (right side). Name of the boy is "Sidr". She lost her mother, a brother, a brother in low in the cyclone.	

Barguna District Barguna Sadar Upazila Badarkhali Union : Hazard map developed by USAID and Save the Children. Community people thing this map is usuful.

Bagerhat District Mongla Upazila :   Equipment such as PC, TEL, FAX, and a copy machine, printer, in PIO/DMIC office

Sarankhola Upazila_Randa Union: Interview survey to community people including women,

And fisher men

Summary

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Abbreviations

ADB	Asian Development Bank
AWS	Automatic Weather Station
BCCRF	Bangladesh Climate Change Resilience Fund
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BCCTF	Bangladesh Climate Change Trust Fund
BCCU	Bangladesh Climate Change Unit
BDRCS	Bangladesh Red Crescent Society
BDT	Bangladesh Taka
BIWTA	Bangladesh Internal Water Transport Authority
BMD	Bangladesh Meteorological Department
BTV	Bangladesh Television
BWDB	Bangladesh Water Development Board
CBDRM	Community Based Disaster Risk Management
CCDMC	City Cooperation Disaster Management Committee
CDMP	Comprehensive Disaster Management Programme
CDS	Coastal Development Strategy
CDSP	Char Development and Settlement Project
CEIP	Coastal Embankment Improvement Project
CIF	Climate Investment Fund
CPP	Cyclone Preparedness Programme
CPPIB	CPP Implementation Board
CSO	Civil Society Organization
CZPO	Coastal Zone Policy
DANIDA	Danish International Development Agency
DC	Deputy Commissioner
DDM	Department of Disaster Management
DG	Director General
DMB	Disaster Management Bureau
DMC	Disaster Management Committee
DMIC	Disaster Management Information Centre
DPHE	Department of Public Health Engineering
DRR	Disaster Risk Reduction
DRRO	District Relief & Rehabilitation Officer
DTMF	Dual Tone Multi-Frequency
ECPP	Enhancement of Cyclone Preparedness Program
ECRRP	Emergency Cyclone Recovery and Restoration Project

EIA	Environment Impact Assessment
EU	European Union
EWS	Early Warning System
FAO	Food and Agricultural Organization of the United Nations
FCS	Fishermen Cooperative Society
FFWC	Flood Forecasting & Warning Center
GDP	Gross Domestic Product
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GoB	Government of Bangladesh
GoJ	Government of Japan
GPS	Government Primary School
HF	High Frequency
HQ	Head Quarters
ICZM	Integrated Coastal Zone Management
IFAD	International Fund for Agricultural Development
IMD	India Meteorological Department
IMDMCC	Inter-Ministerial Disaster Management Coordination Committee
IT	Information Technology
ITC	Information Technology and Communication
ITU	International Telegraph Union
IWRM	Integrated Water Resource Management
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
JPY	Japanese Yen
LGED	Local Government Engineering Department
MDGs	Millennium Development Goals
MoDMR	Ministry of Disaster Management and Relief
MoEF	Ministry of Environment and Forests
MoFDM	Ministry of Food and Disaster Management
MoWR	Ministry of Water Resources
NAPA	National Adaptation Program of Action
NDMC	National Disaster Management Council
NGO	Non-Governmental Organizations
NPDM	National Plan for Disaster Management
NPDRR	National Platform for Disaster Risk Reduction
NWMP	National Water Management Plan

NWP	National Water Policy
PCU	Project Coordination Unit
PIO	Project Implementing Officer
RRI	River Research Institute
SAARC	South Asia Association for Regional Cooperation
SCF	Strategic Climate Fund
SDC	Swiss Agency for Development and Cooperation
SFYP	Sixth Five Year Plan
SLR	Sea Level Rise
SMC	School Management Committee
SMS	Short Message Service
SOD	Standing Orders on Disaster
SPCR	Strategic Program for Climate Resilience
SWC	Storm Warning Centre
UEO	Upazila Education Officer
UDMC	Union Disaster Management Committee
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
UNO	Upazila Nirbahi Officer (Upazila Executive Officer)
UP	Union Parisad
UPS	Uninterruptible Power Supply
USAID	United States Agency for International Development
USD	United States Dollar
VHF	Very High Frequency
WB	World Bank
WHO	World Health Organization

1. Introduction

1.1. Background and Objectives of Survey

(1) Background of Survey

Natural disasters such as floods and cyclones hit the People's Republic of Bangladesh (hereinafter "Bangladesh") every year, and the annual economic loss from these disasters accounts to about 600 million yen (equivalent to about 6.49 million US dollars as of Feb. 2013). Damage from cyclones which occur in the Indian Ocean is relatively huge. The cyclone of 1970 caused the worst damage, and more than 300 thousand people lost their lives. Even though the number of victims has been decreasing, more than a thousand people lost their lives from Cyclone Sidr (November 2007).

In the Sixth Five Year Plan 2011-2015, disaster risk management is considered as one of the focal areas. The economic loss from disasters from 1990 to 2008 amounts to 2,189 million US dollars (1.8% of Gross Domestic Product (GDP)). The government of Bangladesh (GoB) plans to increase the budget for disaster risk management to twice as much than that of the past in the period of 2011-2015.

At the legislative level, amendments of the National Plan for Disaster Management and the Standing Orders on Disaster (SOD) were formulated in 2010. In September 2012, the Disaster Management Act was enforced, and the Ministry of Food and Disaster Management was divided into the Ministry of Food and the Ministry of Disaster Management and Relief. The Department of Disaster Management was newly established. The government plans to formulate the National Disaster Management Policy in 2013.

Because of the intensive development of legislation, the implementation system is facing challenges. Multiple organizations are involved with the disaster information system (for example, organizations for climate and hydrological observations, decision making organizations for early warning and organizations for disaster information transfer to the local governments and community people). Their functions are overlapping, and a communication system among the organizations needs to be developed. Another problem is the speed of disaster information transfer. There is also a problem with community people, who are the receivers of disaster warnings.

Supported by UNDP, a Disaster Management Information Center (DMIC) was established, and an information managing system was developed. However, information has to be collected, and warnings will be announced faster based on analysis of focal organizations.

Focusing on a restoration and reconstruction process, the SOD assigns roles of each

stakeholder at each level of the process. The Order also defines the relationship of the stakeholders. However, related organizations tend not to follow the Order, and community people do not receive adequate support during the process.

Based on the direction of Japanese assistance, 117 cyclone shelters were constructed, and 5 climate observation radars were set up. As technical cooperation projects, some projects were implemented on capacity development for climate observation analysis and establishment of earthquake-resistant public facilities. The Japanese government had been receiving urgent requests from the Bangladesh government in several areas such as comprehensive capacity enhancement on disaster risk management including restoration and reconstruction process and warning to community people in the coastal areas. In Japan, disaster information is announced to community people in a timely manner from the Japan Meteorological Agency with cooperation from the Ministry of Land, Infrastructure, Transport and Tourism and the local governments. Recently, a system called J-ALERT has been developed. The system focuses on both disaster information and emergencies at national level. These good examples of Japan should be effectively used for assistance.

Japanese assistance to Bangladesh mainly focused on capacity enhancement on announcement of warnings and construction of cyclone shelters. Therefore, Japan does not have adequate information on the disaster information system, early warning and community people who are the receivers of disaster warnings. This information needs to be collected to consider the validity of Japanese assistance and middle and long term assistance scenarios.

(2) Objectives of Survey

Objectives of the Survey are as follows.

- To collect basic information on such things as government plans and assistance of other donors for establishment of effective disaster risk management based on early warnings.

- Formulation of an assistance scenario in the coastal area considering the validity of Japanese assistance.

(3) Outline and Workflow of Survey

The period of the Survey is from the middle of March through the end of July 2013. Figure 1.1 shows the workflow of the Survey.

Data Collection Survey on Early Warning and Disaster Information System in Costal Area		
Middle of Mar. 2013	Preliminary work in Japan	【1】 Data colleciton and Analysis 【2】 Preparation of Inception Report 【3】 Participation in Preliminary Meeting
End of Mar. through End of June 2013	Work in Bangladesh	【4】 Explanation of Summary of the Survey to JICA Bangladesh Office 【5】 Explanation of Summary of the Survey to Related Organizations ***Confirmation of Current situations*** 【6】 Data Collection on Superior Plans, Policy and Work Plans of Disaster Management in Coastal Area 【7】 Confirmation of Implementation System and Information Communication System of Bangladesh Government and Related Organizations 【8】 Confirmation of Assistance System and Actual Assistance Given from Donors and NGOs 【9】 Confirmation of Basic Data of the Survey Area 【10】 Survey on Early Warning System and Disaster Information System of Local Governments in the Survey Area 【11】 Confirmation on Early Warning System and Disaster Information System at Community Level 【12】 Confirmation on Behavior Patterns on Evacuation in Community and Restoration Process 【13】 **Preparation of Interim Report** ***Analysis and Formulation of Assistance Scenerio*** 【14】 Analysis of Challenge, High Priority Area for Support on Early Warning and Disaster Information System in Coastal Areas 【15】 Formulation of Assistance Scenario of JICA on Early Warning and Disaster Information System in Coastal Areas 【16】 Information Sharing of Survey Result to Bangladesh Government, Donors, Related Organizations 【17】 Report of Survey Results to JICA Bangladesh Office
End of Jun. through end of Jul. 2013	Work in Japan	【18】 Report of Survey Results at JICA Headquarter Office ⟷ **Discussion with JICA** 【19】 Preparation of Draft Final Report 【20】 Preparation of Final Report

Source: JICA Survey Team

Figure 1.1   Workflow of Survey

(4) List of Survey Team

Members of the survey are listed as follows:

1. Team Leader/
   Comprehensive Disaster Management Plan/ Relief and Rehabilitation Plan — Ryuichi HARA
2. Weather Disaster Management — Tsutomu KURIHARA
3. Early Warning Planning — Kenji MINEGISHI
4. Community Based Disaster Management — Kaoru SASAOKA
5. Disaster Information System/Equipment Plan — Mitsuo YAMASHITA
6. Disaster Information System/Equipment Plan 2 — Mamoru HIRAYAMA

(5) Schedule

This survey is implemented in five (5) months from March to July in 2013. The survey schedule is shown in the Table below.

Table 1.1   Survey Implementation Schedule

Year	2013					
Month	Feb	Mar	Apr	May	Jun	Jul
Site Survey		▮▬▬▬▬▬▬▬▬				
Work in Japan		▭▭▭▭▭▭▭▭▭▭▭▭▭				
Report		△ IC/R	△ IT/R		△ DF/R	△ F/R

IC/R : Inception Report   IT/R: Interim Report   DF/R : Draft Final Report   F/R : Final Report

Source: JICA Survey Team

(6) Survey Area

Interview surveys of organizations related to disaster risk management and site surveys for cyclone shelters were conducted in 12 districts in coastal areas.   The survey area is shown in Table1.2 and Figure1.2.

Table 1.2   Survey Area

Khulna Division	Barisal Division	Chittagong Division
Bagerhat District	**Barguna District**	**Chittagong District**
Upazila Mongla	Upazila Barguna Sadar	Upazila Banshkhali
Chila Union	Badarkhali Union	Baharchhara Union
Upazila Sarankhola	Naltona Union	Chhonua Union
Raynda Union	Upaziia Patharghata	Upazila Sandwip
Southkhali Union	Charduanti Union	Rahmatpur Union
Khulna District	Patharghata sadar Union	Sharikaito Union
Upazila Dacope	**Bhola District**	**Cox's Bazar District**
Kamarkhola Union	Upazila Charfassion	Upazila Kutbudia
Sutarkhali Union	Char Madraj Union	Koiyarbill Union
Upazila Koyra	Dar Char Union	Lemshikhali Union
North Bathkashi Union	Upazila Lalmohan	Upazila Maheshkhali
South Bathkashi Union	Dholigour Nagar Union	Kutubjum Union
Satkhila District	Lord Harding Union	Matarbari Union
Upazila Shyamnagar	Upazila Manpura	**Feni District**
Gabura Union	Hazirhat Union	Upazila Sonagazi
Padmapkur Union	Manpura Union Parisad	Char Chandia Union
	Patuakhali District	Char Darbesh Union
	Upazila Galachipa	**Lakshmipur District**
	Amkhola Union	Upazila Ramgati
	Ratandi Taltali Union	Char Abdullah Union
	Upazila Kalapara	Char Alexander Union
	Lata Chapli Union	**Noakhali District**
	Tiakhali Union	Upazila Hatiya
	Pirojpur District	Jahaj Mara Union
	Upazila Mathbaria	Nizhum Dwip Union
	Baramasua Union	Upazila Subarna Char
	Bethmore Rajpara Union	Mohammadpur Union
		Pobra Char Bata Union

Source: JICA Survey Team
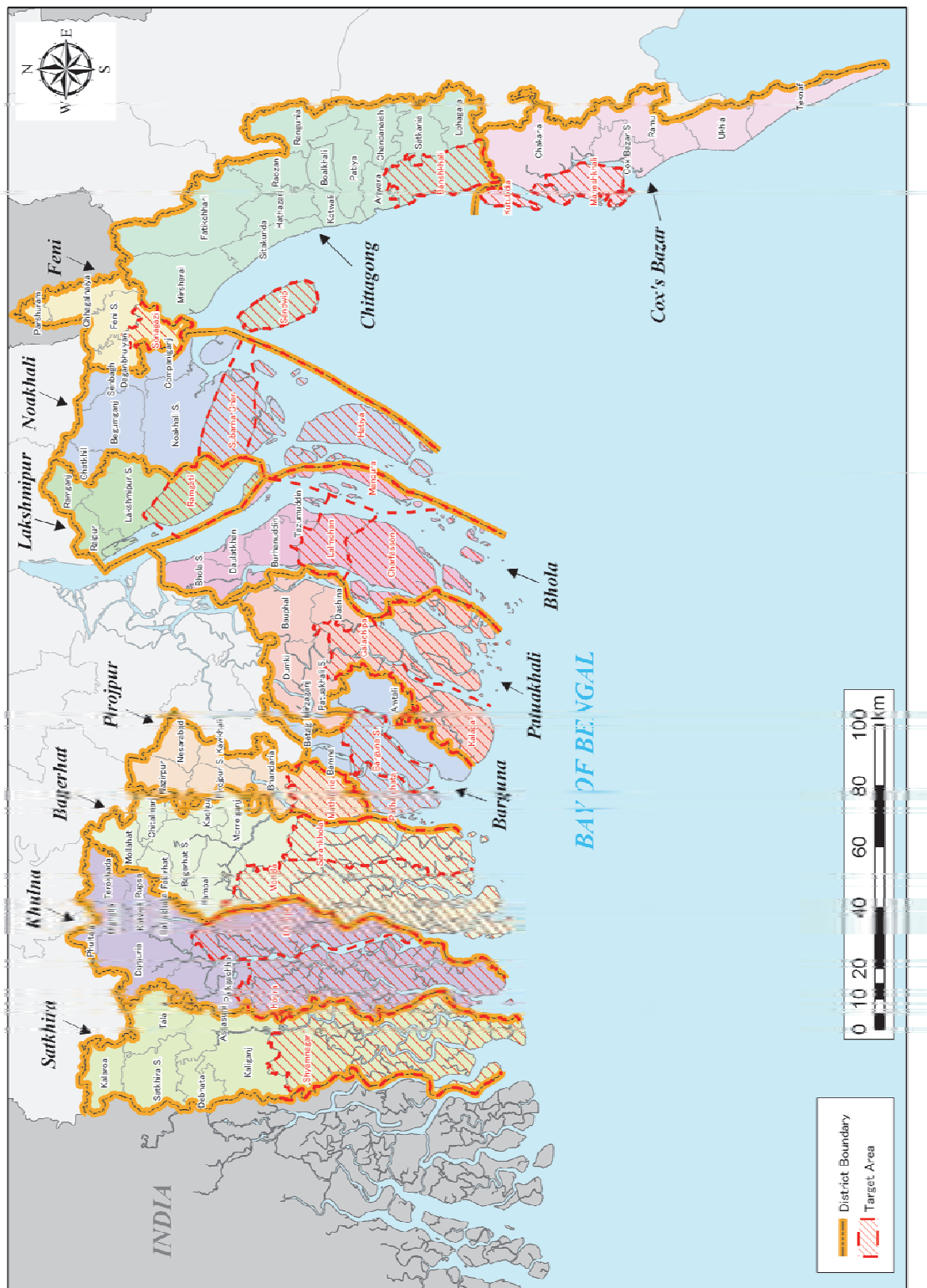
Source: JICA Survey Team

Figure 1.2   Survey Area

2. Current Status of Organizations related to Early Warning and Disaster Information System

2.1. Government Organizations

(1) Department of Disaster Management (DDM)

Current status and issues of DDM are shown below.

a) Manpower of Staff

In District level, there are several staffs in charge of disaster risk management including District Relief and Rehabilitation Officer (DRRO) and DMIC. However, in Upazila level, there are two (2) staffs of Project Implementation Officer (PIO) and Office Assistant. Below Union level, there is no staff. Therefore, Union, the smallest administrative level practically, is very vulnerable.

The Ministry of Disaster Management and Relief (MoDMR) and the Department of Disaster Management (DDM) were newly formulated by the Disaster Management Act. Therefore, activities are to be taken from now on. One of the biggest problems is insufficient number of staffs in charge of disaster risk management partly because they are dependent on Cyclone Preparedness Programmes (CPPs), which were formulated from the 1970's regarding cyclones. Another problem is that few training and seminar have been held, therefore capacity development for not only early warning and disaster information system but also all over disaster risk management is required.

b) Budget for Disaster Risk Management

Local government does not have enough budgets for disaster risk management. Most of Districts have only 100,000-200,000 BDT for disaster relief fund and around 50 tons of rice as stock for disasters. The budget for training is not ensured in most cases.

The number of cyclone shelters and development of disaster information system are inadequate. Normal activities such as training, education, and seminar of disaster risk management have not been conducted adequately due to insufficient budgets by their own budgets, and donors and Non-Governmental Organizations (NGOs) implement projects. Therefore, insufficient budgets for disaster risk management are one of the most important issues.

c) Difference of Activities depending on Years of CPPs Established

Activities related to disaster risk management are different from area to area below District level. PIOs in some Districts prepare a list of cyclone shelters and disaster risk reduction campaigns, but PIOs of other District do not.

Activities of Department of Disaster Management (DMC)/Disaster Management Information Centre (DMIC) are different from area to area. In areas CPP established in 1970's, activities of CPPs are almost very active, on the other hand, activities of DMC/DMIC are not so active in these areas. Of course, there are some areas CPPs and DMCs/DMICs are in good collaboration, but they are only in limited areas. It is noted that CPP members are eager to fulfill their tasks even they do not have adequate experience, equipment and offices.

On the other hand, for example, in Khulna Division, CPPs have been organized after Cyclone Aila in 2009. These CPPs have not had enough experience of activities of disaster risk management. Therefore, activities of DMCs/DMICs are more active compared to that of CPPs. Originally these areas have not been affected by cyclones so much, CPPs were not organized before Cyclone Aila (May 2009). That means DMCs/DMICs have not been had so much experience. Therefore in these areas, training for disaster risk management are required for not only CPPs but also DMCs/DMICs.

d) List of Cyclone Shelters

Comprehensive Disaster Management Programme (CDMP) has been preparing database of cyclone shelters and location maps. However in this database, there are some lacks of cyclone shelter data depending on organizations which constructed cyclone shelters or managing cyclone shelters. At the moment, database in Khulna division have been prepared, however preparation/update of database of whole cyclone vulnerable areas is one of the most important issues to be handled. And also analysis of areas with insufficient numbers of cyclone shelters is the one of the most important issues to be deal with immediately. And based on the data, to prepare a master plan for cyclone shelters and evacuation plans are one of the highest priorities.

e) Capacity Development of Disaster Risk Management for Organizations related to Disaster Risk Management including Community People

DMIC was established in CDMP and it was recognized up to District level. However, some Upazilas do not recognize DMIC, therefore, at the moment, the mission of DMIC has not been clear to all levels of local governments. In the future, DMIC should be the one of the key center for disaster risk management. Therefore, activation of DMIC is one of the most important issues. Also training/ disaster risk management education for DMCs and community people is one of the most important issues.

(2) Bangladesh Meteorological Department (BMD)

a) Function/Role

Weather observation and forecasting services in Bangladesh are under the jurisdiction of the Bangladesh Meteorological Department (BMD). BMD carries out surface observation and other various observation systems using radar, pilot balloons, radiosonde, meteorological

satellite, etc. Weather forecasting services are provided not only by using the data obtained from the above mentioned observations but also in association with other countries such as India. The Storm Warning Center (SWC) under BMD is the solely authorized organization for forecasting and early warning of cyclones. BMD manages the following internet website (http://www.bmd.gov.bd), and provides useful information on cyclones including special weather bulletin, observed cyclone tracks, estimated cyclone paths, meteorological satellite images and weather charts.
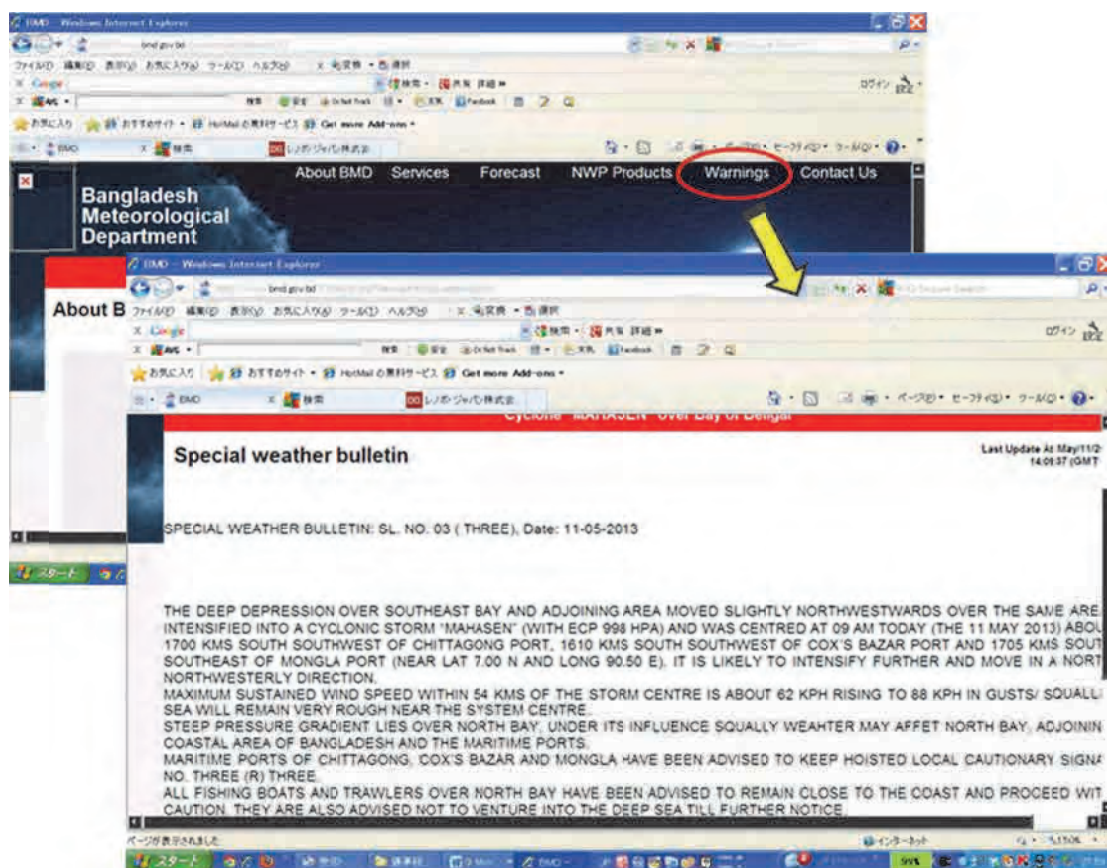
【Special Weather Bulletin】

Figure 2.1 Information on Cyclone Mahasen in 2013 provided by Website of BMD

b) **Tidal Level Observation**

BMD does not observe tidal levels or sea water levels.

BIWTA (Bangladesh Internal Water Transport Authority) observes tidal levels for the purpose of navigation in about 30 observation stations. Based on the observed data, BIWTA publishes a tide table. However, the existing tidal observation system is not suitable for observing storm surges which increase the sea/river water level rapidly and significantly.

c) **Issues for Forecast and Warning Dissemination**

BMD has applied ten (10) warning system of ten signal levels for the maritime ports and

four (4) signal levels for the inland ports, and has designated evacuation styles for each signal level.   However, in the signal levels of the SOD, there was found some different description from the original meanings of signal levels in BMD.   For example, some parts of the explanation of the warning were deleted in the SOD.

Since the SOD was revised in 2010, the government has made efforts to establish a six (6) -level warning which residents can easily get used to.   However the new signal level system has not been recognized yet.   There must be great confusion among CPP and residents for the revision of the existing ten levels of warning signals.

Under the same signal, the weather condition differs area to area.   Sometimes it happens that it is quite sunny under signal 10.   On the contrary, a whole island can be inundated under signal 4 unfortunately.   Setting up of signals in small scale is needed.   However, capacity development of forecasting and development of weather observation stations are essential for that.

As a challenge for forecast and warning of meteorological disasters, the accuracy of information needs to be improved.   The existing ground meteorological observation network cannot forecast small- or meso-scale weather conditions such as thunder storm.

As a challenge for information dissemination, it is needed to develop the capacity of local DMC/DMIC officials and CPP leaders of below Upazila level in order to properly understand the meteorological information provided by BMD, and disseminate accurate information to all residents. Wrong information may be disseminated due to misunderstanding of the information which results from lack of basic meteorological knowledge such as eye of the cyclone or dangerous/navigable semi-circles. A systematic training is essential for persons in charge of local disaster risk management of below Upazila level.

Improvement of reliability is needed by establishing information transmission system. Signal is disseminated only when the signal goes up.   Therefore, community people do not know the actual situation, and they get confused.   Development of appropriate information transmission is recommended.

Regarding water level information, the case that the whole island was inundated under signal 4, warnings were not issued because water level information could not be obtained.   The SOD does not mention about water level information.   Moreover, information which should be provided from BMD does not include water level information.   The information is strongly recommended to be added.

(3) Bangladesh Water Development Board (BWDB)

128 water level observation stations operated by the Bangladesh Water Development Board

(BWDB) have been installed in the estuarine basin.   Cyclone disasters are related to storm surge, therefore water level information is quite important for the cyclone early warning system.   However, the information is not shared with other related organizations.   According to the SOD, it says "provide flood early warning", but regarding water level, it only says "observe water level".   Therefore, the SOD is recommended to be revised.

The survey team conducted a site reconnaissance for a water level station in Hatia Upazila Noakhali District.   The height of the water level meter is only three (3) meters, but at least 6-7 meters is required in an estuarine basin.   As the water level meter is installed in a place where the land is easy to erode.   Management of equipment is inadequate.

They observe the water level five (5) times a day (6:00 am, 9:00 am, 12:00 pm, 3:00 pm, 6:00 pm) and the data are sent to the Comilla branch office of BWDB every month by mail. Also they do not change the number of observations in a day even during cyclone times.

(4) Ministry of Environment and Forest (MoEF)

With regard to disaster risk management, the most important role of the Ministry of Environment and Forest (MoEF) is implementation and supervision of the Bangladesh Climate Change Strategy and Action Plan (BCCSAP2009) and management of the Bangladesh Climate Change Trust Fund (BCCTF).   The actual fund allocation for the field of "comprehensive disaster management" under BCCTF was 11% of the total fund in 2011.   Other than that, improvement and strengthening of polders[4] are included in the field of "infrastructure" which takes the first place of the share.   As the fund amounts to about 18 billion Japanese yen in 2013, the fund is expected as a driving force of disaster risk management projects listed in Bangladesh Climate Change Strategy and Action Plan (BCCSAP).

2.2.   Cyclone Preparedness Programme (CPP)

The current status of CPP is shown below.

(1) Organization/ Budget

The organization of the CPP is quite good and there should be no problem in the organization itself.   However, one of the biggest problems is that there are quite few budgets for management, maintenance and activities of disaster risk management.

The budget for maintenance is allocated up to Upazila level from the governmental budget,

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[4] Polder: An embankment or dike

however CPP Upazila offices can get only 20-30 % of the actual cost, and staffs of CPP have to pay the remainder from their personal money.

The issues regarding maintenance fee are shown below.

- Mongla (Bagerhat), Assasuni(Satkhira), Shyamnagar(Satkhira), Koyra (Khulna), Dakope (Khulna) Upazila CPP offices do not have any budget for maintenance at the moment because they do not have their offices.

- Monthly budget for the fixed line phone in the Upazila level is only 300 BDT, which is not at all enough.

- There is no budget for the mobile phone usage.

- No budget is allocated for maintaining of the computer and printer facilities. The ink for the printer has been bought by the Upazila officers from their personal money.

- Only ten (10) liters of oil is allocated for the motorcycle/vehicle in each Upazila level.

- Government officials of CPP do not receive any extra money for overtime.

- The electric bill amount is fixed. Most of the time with the allocated budget for the electric bill does not cover the requirements.

- Only 320 BDT is allocated for the cleaner which is totally inhuman. As a result, it often happens that CPP Upazila officers paid extra money to the cleaner from their personal money.

- No fund is allocated for training purposes.

(2) Differences of Activities for Disaster Risk Management and Necessity of Trainings and Disaster Risk Management Education

In Khulna Division, activities for disaster risk management are not so active due to the late establishment of CPPs. According to the interview survey, they reported the rate of transmission of information was more than 70% in the area of CPP established in the 1970's. However in Khulna Division, the rate of transmission of information was less than 50%. At the moment, although CDMP has been conducting assistance projects, the rate of transmission of information has remained low.

Training and disaster management projects are necessary in the areas CPPs established after Cyclone Aila (May 2009). Even the areas CPP established in the 1970's, training and disaster management education have not been implemented adequately for the members of CPP, DMC and community people. Therefore, training and disaster management education for early warning are one of the most important issues in the coastal area.

Equipment for early warning in the CPPs established in the 1970's are old and most of them are out of order at the moment. Only around 20% of them are working. Even though

equipment in the CPPs newly established is sometimes better than old CPP's, the number of equipment is absolutely insufficient.

3. Activities During Cyclone Mahasen in 2013

3.1. Damage Situation by the Cyclone

(1) The Damage Situation

When Cyclone Mahasen hit, the survey team was staying at Chittagong and the Cox's Bazar District. Cyclone information of District, Upazila, Union, and the radio stations was collected.

The storm finally hit the southern coastal village of Khepupara 7:00 am, Thursday on the 16th May 2013 with a wind speed of 62 mph. According to the Dupty Commissionar, (DC) Barishal, 17 people died of the cyclone. Among them, seven (7) died in Barguna, four (4) in Bhola, three (3)in Patuakhali , one (1) in Pirojpur and two(2) in Chittagong.

Kalapara Upazila was the worst affected area in Patuakhali. Over 100 people were injured in house and tree collapses in Rangabali Upazila of Patuakhali. Around 15,000 thatched and tin-roofed houses were destroyed in the Upazila. The storm surge washed away flood protection dams at the north and south points at Goyalkhali Bazar in Mujibnagar Union of Charfassion Upazila in Bhola District, threatening three villages.

A total of 123 mm of rainfall was recorded in Patuakhali District in 12 hours till 6:00 am Thursday. Coastal areas were remaining under five feet water around 10:00 am.

The Bangladesh Meteorological Department (BMD) lost communication with its sub-station in Bhola after the cyclone hit the area, several mobile phone towers were uprooted, disrupting the telecommunication network.

Blackouts occurred in seven (7) Upazilas in Barguna District on May 15th at 7:00 am. The power supply of the District was suspended from the 15th 2:30 am to the 16th during the morning. Road networks were also disturbed, ships were suspended as well.

Blackouts occurred in Barisal as well on May 16th from 2:30 am.
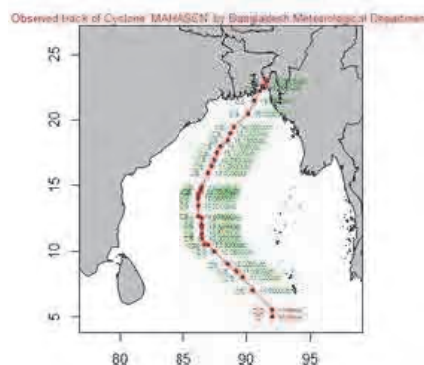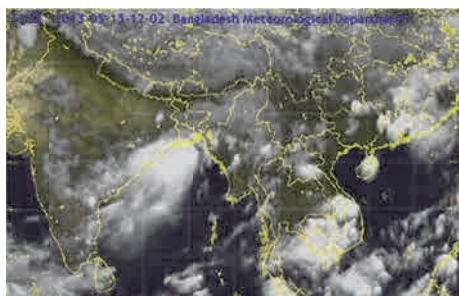
Figure 3.1   Satellite Image of Cyclone Mahasen (left) and Path of Cyclone Mahasen (right)

Source: Web site of BMD

(2) Coverage related to Cyclone Mahasen

<u>May 12th The Daily Star newspaper</u>

- Maritime parts of Chittagong, Cox's Bazar and Mongla have been advised to keep hoisted local cautionary signal No. three, according to a bulletin of the Meteorological department.

- At 6:00 am today (Sunday), it was centered about 1520 km south-southwest of Chittagong Port, 1430 km south-southwest of Cox's Bazar Port and 1485 km south-southeast of Mongla Port.

- The maximum sustained wind speed of the storm center is about 54 km per hour. The wind speed is increasing 62 km to 88 km per hour. All fishing boats and trawlers over the North Bay were advised to remain close to the coast.

<u>May 14th The Independent</u>

- The minister of MoDMR, Abul Hassan Mahmud Ali, announced necessary preparation was made against Cyclone Mahasen.

- The details of the preparation was 50,000 volunteers, 3,770 cyclone shelters etc.. The disaster prevention scheme had been implemented in 322 Unions, 13 Upazilas, and in 13 District. According to BMD, the predicted path of Cyclone Mahasen was to be confirmed by Wednesday (May 15th) at night.

- The government announced not to use damaged cyclone shelters. Elementary schools were assigned as evacuation sites. 50,000 trained volunteers were ready at each area. Holidays had been cancelled for all governmental staff such as Deputy Commissioner, Upazila Chairman and Union Chairman.

- As emergency supplies, 5,000 tents, 7,000 saris and rungis, 100 tons of food which was equivalent to 300,000BDT were in stock.

- For areas where the disaster prevention scheme has been implemented, a medical team at Union level, two (2) medical teams at Upazila level and five (5) medical teams at District level had been allocated for emergency and rescue activities.

- National Disaster Risk Management Coordination Unit monitors the cyclone the unit was allocated at District level. Mr. Mohammad Shah Alam of BMD reported that the cyclone was 1,080 km away from Chittagong port, 1,015 km away from Cox's Bazar port and 970 km away from Mongla port. The speed was slower than yesterday (May 13th (Monday)), and if the speed remained as it is, it takes time to reach Bangladesh. There was a possibility the speed increase as it approaches to Bangladesh.

- If the cyclone approaches along with the predicted course, there is a possibility that the cyclone hit the border of Bangladesh and Myanmar. If the cyclone changes the course, it will hit Chittagong and Sundarban.

- The government issued signal 4 to coastal areas, and requested to evacuate to safe places to community people and fishermen. Disaster risk management volunteers were requesting to people to prepare for evacuations.

<u>May 15th The Independent</u>

- As of May 15th (Wednesday), 9:00 am, Cyclone Mahasen was 875 km away from Chittagong port, 815 km away from Cox's Bazar port, and 760 km away from Mongla port, and was moving toward north-northeast.   The atmospheric pressure at the center was 996 hPa.

- The cyclone was possibly developed more, and there was a possibility it passes between Khepupara-Teknuf near Chittagong, near Chittagong.   Due to the cyclone, it was forecasted for a gust of wind and heavy rains after 10pm.

- The maximum sustained wind speed of the storm center is about 54 km per hour.   The wind speed is increasing 62 km to 88 km per hour.   The sea is very rough.   The warning was 4 to 7in Districts such as Cox's Bazar, Chittagong, Noakhali, Laxmipur. The singal was 5 at Mongla port, Pirojpur, Jlakathi, Bagerhat, Khuln and Satkhira.

<u>May 16th The Daily Star newspaper</u>

- Cyclone Mahasen hit the coast of Patuakhali District.   Damage from the cyclone was not unknown but at leaser 6 people are dead in Patuakhali, Barguna and Bhola.   The cyclone passed Kuakata coast at 21 km per hour to the east.

- A man at the age of 75 was dead in Lalmohan Upazila, Bhola by being hit by a tree around 8:15am.

- A boy at the age of 6 was dead in Charfession, Bhola by being hit by a tree.

- A man at the age of 75 in Betagi Upazila, Barguna was dead by being squashed by a tree.

- A boy at the age of 6 was dead in Sadar Upazila, Patuakhali due to a death from shock by thunder.

- A woman at the age of 65 was dead in Taltoli Upazila, Patuakhali by being squashed by a tree.

- A woman at the age of 50 was dead in Colachipa Upazila, Patuakhali by being squashed by a tree.

- More than 100 people got injured due to house and tree collapses.   More than 15,000 houses were collapses.   123 mm of rainfall was recorded for 12 hours (May 15th 6:00 am to the 16th 6:00 am).

<u>May 17th The Daily Star newspaper</u>

- On the morning of 16 May, cyclonic storm Mahasen made landfall in Patuakhali district in southern Bangladesh moved forward to the northeast away from Myanmar, weakened and dissipated on 17 May.

- Most of the more than 1 million coastal residents who took shelter from the cyclone have returned home and the Government has started door-to-door assessment of the damage caused by the cyclone to support those affected, he said.

- Assessments indicate that there is no significant damage; however there are localized flooding which may see limited needs for provision of drinking water, sanitation and hygiene, and temporary shelter to people who have been affected.

- Heavy rains and fierce winds that flattened mud and straw huts and forced the evacuation of more than 1 million people.

May 18th The Daily Star newspaper

- Relevant storm tracking sites stopped tracking the weather system once it moved over northern Bangladesh early on 17 May.

- The district of Barguna in the south-west Bangladesh was the hardest hit, reporting seven dead and a massive power failure.

- "There is no electricity.   The mobile networks have been damaged," said Abdul Wahhab Bhuiyan, deputy commissioner of Barguna.   "The total damage is difficult to ascertain at this time."

- Although assessments were continuing Sarker said that besides crops about 7,500 houses were damaged in the cyclone.

- Bangladeshi authorities on Friday started delivering aid to thousands of families whose homes were destroyed by Cyclone Mahasen, which officials said killed 17 people.

- More than 49,000 thatched houses were destroyed when the cyclone hit the Bay of Bengal late on Thursday, the chief of the country's disaster management department Abdul Wazed told DPA by phone.

- The Government of Bangladesh reported 14 deaths, 65 injured persons.

- Cyclone Mahasen was weakened in its strength from category 3 to tropical storm, category 1, the weakest level.

- Most of the deaths were caused due to trees falling or homes collapsing as noted.

- Heavy rain and fierce winds that flattened mud and straw huts and forced the evacuation of more than 1 million people.

- A total of 1,285,508 people were affected by the storm throughout the country.

- At least 17 people were killed across the country, thousands of people were also injured and many livestock were killed.

3.2.   The Correspondence Situation to Cyclone Mahasen

Based on their past disaster experience, the GoB took some very timely measures during Cyclone Mahasen.   Fortunately as they received the information about formation of the depression very early, they had time to prepare themselves and warn community people.   Yet, the signal was 7 in Chittagong and Cox's Bazaar ports, which were least affected but in Mongla

port, it was signal 5, which is very near to Potuakhali; the area where Cyclone Mahasen hit and caused the death of 15 as it clutched to the land.

The survey team attended two District level DMC meetings, and experienced government preparatory activities during Cyclone Mahasen (May 2013).

(1) The Contents of the Chittagong DMC meeting

The Chittagong DMC meeting was held on the 12th of May, 1 pm, when the signal was 3. Chittagong is an important port area, and they have a huge population to cover. Therefore, although the DMC meeting was supposed to be held after the signal reached 4, they called them earlier as a precaution.

The DC had a brief orientation with the committee members and explained the issue of the meeting that they received a fax from the prime minister's office after 9 pm on the 11th that the depression had become into Cyclone 'Mahasen'. It was still far away from Bangladesh, but it could turn into a great danger for the country. He mentioned that his concern was about Chittagong, so that the community that were most vulnerable and lived near the coastal area could reach safe shelters. CPP AD (in charge), national media, members of the armed forces, fire service, civil surgeon, agriculture and fisheries officers and most of the DMC members joined the meeting.

Then each member explained their preparation.

Agricultural Department:

- This was harvesting season for paddies and only 30% crops had been harvested. They would send information to Upazila agriculture office so that they could send this massage to the residents that they had to harvest all their crops within the next few days.

Livestock Department:

- He would inform the UNOs to bring all the livestocks to killas[5].

CPP:

- The CPP AD (in charge) Bodrul Islam explained their cactivities in 6 Upazilas of the District. He reported that the fishermen were already informed to stay on shore.

- Cyclone Mahasen that the cyclone was 1520 km away from Chittagong and it was moving in a North-North west direction. They were hoping that it would lose force and would not cause any more death but from its direction, it still had a possibility to hit

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[5] Killa: An Elevated area which is constructed for evacuation site of livestock.

Bangladesh.

Ministry of Defense:

- The country had experienced another unfortunate national occurrence; the collapse of Rana plaza in Savar, and most of their rescue staffs were engaged there. So, they could accumulate their manpower within one day, it would take another two (2) days.

A Member of Medical Team:

- The Civil surgeon expressed his concerns about landslides and also assured others that he would be ready with his medical team for post disaster support on behalf of government.

The local correspondents of respective areas:

- They reported that there were some damaged parts in Bashkhali and Shatkania polders. Residents of those areas should have been informed earlier.

Control Room in DC Office:

- The control room was in the DC office and they would create a smaller committee to maintain communication with the control room staff. DRRO shared his land line phone number and mobile number for full time communication.

DRRO:

- The smaller committee to maintain communication with DRRO was composed of five members.

DC:

- The DC strictly advised everyone that there would be no announcements now as it would create more problems. They arranged to distribute tents in the areas where there were no cyclone shelters and in the areas where landslides might occur.

The DC and DRRO summarized their decisions that it was Sunday and according to the forecast, the cyclone would hit on Wednesday. They had to prepare dry food and water for distribution.

(2) The contents of a Cox Bazar DMC meeting

About 50 District DMC members attended the meeting, and the arrangements were carried out for about 2 hours.

Health Department:
- 113 teams were ready to work during the disaster.
- All medical facilities would be provided.

Food Department:
- They would provide food during the disaster time. 5720 tons of food was ready in

stock.

Water Development Board:

- The entire polder would be saved.   They would try to save the polder.

Storm Warning Centre:

- It was moving north and north west.   It was now close to Sri Lanka.
- When the signal would be 4, people had to be ready to face the cyclone
- When the signal is 5, then it would be sure that it would hit Bangladesh.
- Inform the head of the fishermen about the cyclone.

CPP:

- Lots of fishermen died during the disaster.   They had already contacted the fishermen and told them not to go to the deep sea.
- Total members of CPP is 6665.

Fire Service:

- Cox's Bazar, Chokholia, Pekua they have a fire service department.
- DC informed all government officials not to take any government holiday

Animal Department:

- They requested all agencies to think about animal's safety.

Red Crescent:

- All members of the Red Crescent were ready for the disaster.   They had lots of trained persons who would be able to help during the disaster.

Public Health:

- They informed all the stations to be ready for the disaster.   After the disaster if the water points and tube wells got damaged, they would fix them after the disaster.

Fisheries Department:

- DC ordered fishermen not to go to the sea for fishing.

Local Radio:

- They would inform local people about the meeting information.

Businessmen:

- DC ordered them to go to stores to obtain dry food for two (2) days.

School:

- No school headmaster could take a holiday.

DC:

- He would keep ready 534 cyclone shelters in order to use them for the disaster. One control room would be open today. The contact number was- 64254, code 0342. It would be open for 24 hours. Dry food will be stocked for the disaster. Upazila level meeting will be held every day unless and until the signal went down.

Fishing Boat Owners:

- All fishing boats, Trawlers and Marine vessels over the north bay and deep sea were advised to come close to the coast and remain near the coast.

3.3. Information Transfer Situation to Each Organ Concerned with Cyclone Mahasen

The transfer situation to each organization is as follows. The DDM line was delayed 1.5 hours more than CPP line in normal working hours, and out of the working hours, almost six (6) hours behind CPP. This happened in only a part of local governments, however it was a very important time loss considering information transfer to the community people.

(1) Whole Working Hour

- It took two (2) hours 15 minutes on average from issuing of warning by SWC until issuing warning at Union level through the CPP line, and it took six (6) hours 1 minute through the DDM line. The difference of time was three (3) hours and 46 minutes.

- The longest time was 17 hours five (5) minutes (12th May, 2013/ Bulletin 8) in DDM line. And the shortest was one (1) hour and 15 minutes.

- The longest time was three (3) hours 30 minutes (14th May, 2013/ Bulletin 20) in CPP line. And the shortest was 50 minutes.

- The reason why the information transfer time was longer through the DDM line is shown below.

  - ✓ It took a long time for internal processing in DDM-HQ.

  - ✓ It sometimes took a long time for internal processing in local governments.

  - ✓ It was impossible to deal with bulletins out of working time from SWC.

(2) Normal Working Hour

- It took one (1) hour 56 minutes on average from issuing of warning by SWC until issuing warning in Union level through CPP line, and it took three (3) hours 20 minutes through DDM line. The difference of time was one (1) hour and 34 minutes.

- The longest time was five (5) hours 50 minutes (12th May, 2013/ Bulletin 7) in DDM line. And the shortest was one (1) hour and 55 minutes.

- The longest time was two (2) hours 50 minutes (13th May, 2013/ Bulletin 11) in CPP line.   And the shortest was one (1) hour 15 minutes.

- The reason why information transfer time was longer than CPP through DDM line is shown below.

    ✓ It took five (5) hours for internal processing in DDM-HQ (12.05. 2013/ Bulletin 7).

(3) Out of Working Hour

- It took two (2) hours 31 minutes average from issuing of warning by SWC until issuing warning in Union level through CPP line, and it took eight (8) hours 19 minutes through DDM line.   The difference of time was five (5) hours and 48 minutes.

- The longest time was 17 hours five (5) minutes (12th May, 2013/ Bulletin 8) in DDM line.   And the shortest was one (1) hour and 55 minutes.

- The longest time was three (3) hours 15 minutes (14th May, 2013 Bulletin 28) in CPP line.   And the shortest was one (1) hour 15 minutes.

- The reason why information transfer time was longer than CPP through DDM line is shown below.

    ✓ DDM-HQ received the warning at 6:30 PM, and sent it at 9:35 PM. It took three (3) hours 5 minutes for internal processing in DDM-HQ (12th May, 2013/ Bulletin 8).

    ✓ DDM-District received the warning at 9:55 PM, and sent it at 10:50 AM on next day. It took 12 hours 55 minutes for internal processing in DDM-District (12th May, 2013/ Bulletin 8).

Table 3.1   Situation of Information Transfer of Each Organ regarding Cyclone Mahasen

Notice Recommendation Order	Organization DDM/CPP	SWC Send Time a	Transfer time b=c-a	HQ DDM/CPP Receive Time c	HQ Internal processing time d=e-c	HQ Send Time e	Transfer time f=g-e	District DDM Receive Time g	District Internal processing time h=i-g	District Send Time i	Transfer time j=k-i	Upazila DDM/CPP Receive Time k	Upazila Internal processing time L=m-k	Upazila Send Time m	Transfer time n=o-m	Union DDM/CPP Receive Time o	Union Internal processing time p=q-o	Union Send Time q	Total Transfer time r=q-a
Bulletin 3	DDM	12:00 PM	1:05	1:05 PM	0:25	1:30 PM	0:00	1:30 PM	1:00	2:30 PM	0:00	2:30 PM	0:10	2:40 PM	0:00	2:40 PM	0:05	2:45 PM	2:45
Bulletin 3	CPP	12:00 PM	0:00	12:00 PM	0:20	12:20 PM						12:20 PM	0:30	12:50 PM	0:00	12:50 PM	0:50	1:40 PM	1:40
Bulletin 4	DDM	6:30 PM	15:10	9:40 AM	0:10	9:50 AM	0:00	9:50 AM	1:00	10:50 AM	0:00	10:50 AM	0:30	11:20 AM	0:00	11:20 AM	0:10	11:30 AM	17:00
Bulletin 4	CPP	6:30 PM	0:40	7:10 PM	0:40	7:50 PM						7:50 PM	0:55	8:45 PM	0:00	8:45 PM	1:00	9:45 PM	3:15
Bulletin 7	DDM	1:00 PM	4:00	5:00 PM	1:00	6:00 PM	0:00	6:00 PM	0:30	6:30 PM	0:00	6:30 PM	0:15	6:45 PM	0:00	6:45 PM	0:05	6:50 PM	5:50
Bulletin 7	CPP	1:00 PM	1:00	2:00 PM	0:10	2:10 PM						2:10 PM	0:40	2:50 PM	0:00	2:50 PM	0:40	3:30 PM	2:30
Bulletin 8	DDM	6:30 PM	3:05	9:35 PM	0:20	9:55 PM	0:00	9:55 PM	12:55	10:50 AM	0:00	10:50 AM	0:35	11:25 AM	0:00	11:25 AM	0:10	11:35 AM	17:05
Bulletin 8	CPP	6:30 PM	0:50	7:20 PM	0:20	7:40 PM						7:40 PM	0:35	8:15 PM	0:00	8:15 PM	0:40	8:55 PM	2:25
Bulletin 11	DDM	10:00 AM	2:10	12:10 PM	1:00	1:10 PM	0:00	1:10 PM	0:20	1:30 PM	0:00	1:30 PM	0:20	1:50 PM	0:00	1:50 PM	0:05	1:55 PM	3:55
Bulletin 11	CPP	10:00 AM	1:30	11:30 AM	0:10	11:40 AM						11:40 AM	0:20	12:00 PM	0:00	12:00 PM	0:50	12:50 PM	2:50
Bulletin 13	DDM	6:30 PM	1:40	8:10 PM	0:15	8:25 PM	0:00	8:25 PM	0:20	8:45 PM	0:00	8:45 PM	0:10	8:55 PM	0:00	8:55 PM	0:40	9:35 PM	3:05
Bulletin 13	CPP	6:30 PM	0:50	7:20 PM	0:20	7:40 PM						7:40 PM	0:30	8:10 PM	0:00	8:10 PM	0:30	8:40 PM	2:10
Bulletin 16	DDM	10:00 AM	0:50	10:50 AM	0:20	11:10 AM	0:00	11:10 AM	0:15	11:25 AM	0:00	11:25 AM	0:10	11:35 AM	0:00	11:35 AM	0:20	11:55 AM	1:55
Bulletin 16	CPP	10:00 AM	0:40	10:40 AM	0:10	10:50 AM						10:50 AM	0:05	10:55 AM	0:00	10:55 AM	0:40	11:35 AM	1:35
Bulletin 19	DDM	6:30 PM	2:40	9:10 PM	0:20	9:30 PM	0:00	9:30 PM	0:20	9:50 PM	0:00	9:50 PM	0:30	10:20 PM	0:00	10:20 PM	0:20	10:40 PM	4:10
Bulletin 19	CPP	6:30 PM	0:10	6:40 PM	0:10	6:50 PM						6:50 PM	0:00	6:50 PM	0:00	6:50 PM	0:30	7:20 PM	0:50
Bulletin 20	DDM	9:30 PM	0:30	10:00 PM	0:30	10:30 PM	0:00	10:30 PM	0:10	10:40 PM	0:00	10:40 PM	0:30	11:10 PM	0:00	11:10 PM	0:50	12:00 AM	2:30
Bulletin 20	CPP	9:30 PM	1:00	10:30 PM	0:20	10:50 PM						10:50 PM	0:10	11:00 PM	0:00	11:00 PM	2:00	1:00 AM	3:30
Bulletin 26	DDM	3:30 PM	2:15	5:45 PM	0:10	5:55 PM	0:00	5:55 PM	0:05	6:00 PM	0:00	6:00 PM	0:15	6:15 PM	0:00	6:15 PM	0:15	6:30 PM	3:00
Bulletin 26	CPP	3:30 PM	1:00	4:30 PM	0:10	4:40 PM						4:40 PM	0:30	5:10 PM	0:00	5:10 PM	0:10	5:20 PM	1:50
Bulletin 28	DDM	9:45 PM	0:15	10:00 PM	0:25	10:25 PM	0:00	10:25 PM	0:10	10:35 PM	0:00	10:35 PM	0:15	10:50 PM	0:00	10:50 PM	0:10	11:00 PM	1:15
Bulletin 28	CPP	9:45 PM	1:10	10:55 PM	0:10	11:05 PM						11:05 PM	0:30	11:35 PM	0:00	11:35 PM	1:25	1:00 AM	3:15
Bulletin 30	DDM	3:45 AM	12:15	4:00 PM	0:15	4:15 PM	0:00	4:15 PM	0:15	4:30 PM	0:00	4:30 PM	0:15	4:45 PM	0:00	4:45 PM	0:10	4:55 PM	13:10
Bulletin 30	CPP	3:45 AM	0:40	4:25 AM	0:10	4:35 AM						4:35 AM	1:15	5:50 AM	0:00	5:50 AM	0:10	6:00 AM	2:15
Bulletin 35	DDM	4:35 PM	1:25	6:00 PM	0:30	6:30 PM	0:00	6:30 PM	0:10	6:40 PM	0:00	6:40 PM	0:20	7:00 PM	0:00	7:00 PM	0:10	7:10 PM	2:35
Bulletin 35	CPP	4:35 PM	0:00	4:35 PM	0:10	4:45 PM						4:45 PM	0:15	5:00 PM	0:00	5:00 PM	0:50	5:50 PM	1:15

The whole	DDM **6:01**
Average hours	CPP **2:15**
Bulletin was issued during the office hours	DDM 3:20
Average hours	CPP 1:56
Bulletin was issued during off-duty	DDM 8:19
Average hours	CPP 2:31

勤務時間内Bulletin発出 : Bulletin was issued during the office hours.
勤務時間外Bulletin発出 : Bulletin was issued during off-duty.

: Abnormal value

Source: JICA Survey Team

3.4. Verification and the Improvement Item of Correspondence

Government preparation was very much appreciated and in field level, Upazila Nirbahi Officer (UNO), PIO and all associated officers tried their best to deal with the disaster with the limited resources available to them.   But there were some technical shortfalls that need to be mentioned:

- The Storm Warning Centre sent weather bulletins to more than 100 governmental and NGOs, and they sent them one by one.   Therefore, by the time they finished sending one bulletin, the next bulletin was ready.   The JICA team suggested them to use email for faster delivery, and also refer to the mail in a footnote in every fax sent to them.

- A fax can be sent through the internet.   In that case, it does not need to be sent one by one. They can be sent to multiple locations in one go.

- UNO and DC offices have internet access.   They are requested to monitor cyclone information fulltime through the website.

- Usually, bulletins issued after 6 pm are received by government officials the next morning. This time they received SMS as well as phone calls as methods of information delivery, which was very effective.

- In many coastal areas, the capacity of cyclone shelters is not adequate.   Therefore, even if the residents get warnings on time, they cannot take shelter in cyclone shelters and have to look for alternative means at the last hour.

- Government administrations as well as CPP volunteers do not have sufficient vehicles to use during disasters.

- The World Bank (WB) funded sirens are not installed yet, in many areas, they are installed but no one was trained to use them and therefore the sirens did not provide any support during Mahasen.

4.   Early Warning and Disaster Information System

4.1.   Department of Disaster Management (DDM)

(1) Early Warning and Disaster Information System

For the transmission of information, in the DDM line (DDM→DMIC HQ→DMIC District (DC, Disaster Relief and Rehabilitation Officer (DRRO))→DMIC Upazila (UNO/PIO)), a land line can be used, and they can communicate through land line, fax, e-mail and mobile phones.

However below Upazila level, there are almost no land lines, so they mainly use mobile phones for communication.

In the DDM line, they used to use High Frequency (HF) wireless communication system until around 2008.   Recently they can use e-mail due to spread of the internet, therefore they use e-mail instead of HF wireless communication system at the moment.   In some Districts, the HF wireless systems are out of order, but in some District still the system is working.

An issue is that the information is delayed for 2-3 hours than CPP to Upazila level due to time for getting permission of delivering information in each level.

To improve this situation, during Cyclone Mahasen (May 2013), Director General (DG) of DDM delivered SMS messages to DCs, DRROs, UNOs, and PIOs at the same time and they succeeded to shorten the time for transmission of information.   The DG delivered ten (10) SMSs during the period of May 13th to May 16th, 2013, during Cyclone Mahasen (May 2013)[6].

(2)   Megaphone-Siren System Installed by DDM

DDM is now installing Megaphone- Siren System assisted by WB.   At the moment installation of the system has already been completed, but not started to operation because of lack of operators, necessity of repair and no connection to the power at remote stations.   This is a system using an HF/Very High Frequency (VHF) wireless system, and this system will be installed in 56 Upazilas all over the country, and 35 systems will be installed in 12 Districts in coastal areas.   The system consists of wireless system and PC.   The purpose of PC is for obtaining weathercast information from the internet.

Main stations of the system are installed in DMIC or at the office of DRRO of each District, and the system and siren of sub-stations are installed in Upazila Office.   DRRO can control the

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[6] Actually more than 10 SMSs were sent, but some of them were the same.   Therefore, 10 different SMSs were sent.

siren installed in Upazila office from District office. District and Upazila office can communicate through HF wireless system but Upazila office can't communicate other Upazila offices.

There are some issues that even installation has already completed but there is no operator for the system, and there are no staffs who trained for the system. Moreover some sub-stations have not been connected to an electric power supply. And there was no discussion with DRRO and PIO for the place of installation of the system.

The system cannot cover all of the areas of the District, only cover 2-3 Upazilas. Therefore some of staffs do not think the system as main equipment for early warning system, but only for a supplemental system.

4.2. Cyclone Preparedness Program (CPP)

(1) Early Warning System (EWS)

CPP has own information system from HQ to community level. HF wireless is used between HQ and Zones, Upazilas simultaneously. VHF is used between Upazilas and Unions. Mobile phones are used for communication between Unions and Unit leaders. Unit leaders call CPP volunteers and they disseminate the information usually using bicycles and on foot. Figure 1 shows information system of CPP. Communication system of CPP is shown in the table below.

Table 4.1   Information System of CPP

Office			Communication tools	Signal		Language
				4-7	8-10	
HQ	⇔	Zone, Upazila	HF wireless system	-	-	English (Full information)
Upazila	⇔	Union	VHF wireless system	-	-	Bengali (Simplified information)
Union	⇔	Unit Leader	Mobile phone	-	-	Bengali
Unit Leader	⇔	Volunteers	Mobile phone(mainly)	-	-	Bengali
Volunteers	⇔	Community	Face to face By walk, motorcycle, Bicycle	Mosque microphone, Megaphone, etc.	Siren, Megaph one	Bengali/ Local Language

Source: JICA Survey Team

Community volunteers, sometimes they use mosque microphones and megaphones if they can, and if there are no megaphones, they hire megaphones and use them for communication.

Below Union level, contents of information are simplified from original information of HQ in order to make CPP Union members understand the contents of information and they use Bengali or local languages.

(2) Actual Condition of Equipment for EWS

CPPs established after Cyclone Aila (May 2009) have more equipment than CPPs established in the 1970's, however the number of equipment is insufficient.   Also around 80% of the equipment of CPPs which were established in the 1970's is out of order.   CPPs rent megaphones as necessary, CPP members have to pay the rental fee by themselves because of insufficient budget.

In the 1970's, Japan provided megaphones and water proof radios that had worked more than 20 years.   Also some radios provided in 1990's by Japan are still working.   Many donors provided radios 5-6 times after 1990's, but they broke down within one (1) year, the shortest was only three (3) months.   The demand for Japanese equipment is high among CPPs since it generally lasts for a long time.

Recently, CDMP provided windup radios with solar panel made in China, but they broke down in one (1) year.   CPP tried to repair the radios but they were not in common in Bangladesh, so CPPs could not procure parts and repair the radios.   The supply situation of spare parts should be considered.

Therefore, the number of equipment has been less than Cyclone Aila (May 2009) due to trouble of equipment at the moment in some CPPs.

4.3.   Applicability of Equipment related to Early Warning and Disaster Information System

Various conditions have to be considered to select equipment for EWS. Availability of equipment is shown below.

(1)   Internet/ Telephone

a)   Internet

The connection speed to the internet is acceptable in urban areas.   However internet access is still very slow in rural areas.   As an example, according to UNO of Subarno Char Upazila in Noakhali District, an internet circuit of 2 Mbps is installed at the District level, but it is 10 to 15 Kbps at the Upazila level.   An internet circuit of 2 Mbps will be installed by the end of 2013 in a project under "Digital Bangladesh", which the GoB promotes.   The access to the internet will be improved in the future.

b)   Land Line

Generally landlines are installed up to Upazila level, and below Upazila level, mobile phones are used for communication.   At the moment optical fiber has been installed up to District level by a Japanese loan assistance project.

c) **Mobile Phone**

Mobile phones were not so common at the time of Cyclone Sidr (November 2007), but at the time of Cyclone Aila (May, 2009), mobile phones became much more common.

During Cyclone Aila (May 2009), it was said that mobile phone contributed to improving the rate of early warning information dissemination, therefore mobile phones are one of the dominant types of equipment for Early Warning System (EWS).   However, the mobile phone network does not cover all of the cyclone prone areas.   Supplemental information system has to be considered.   According to the results of the interview survey, mobile phones were disconnected due to concentration of access to mobile phones in disaster time, and towers for mobile phones were broken down when the signal level rose up to more than 5-6.

During Cyclone Mahasen (May 2013), mobile phones were disconnected due to concentration of access from 10 am to 4 pm, 15 May, 2013.

A new service to obtain disaster information to call "10941" was started during Cyclone Mahasen (May 2013).   After dialing "10941", push numbers below, information according to the number below can be heard in Bengali.

- 1.:   Information for fishermen
- 2.:   Information for rivers
- 3.:   Information for daily weather forecast
- 4.:   Information for Cyclones
- 5.:   Information for floods

However, this service was also disconnected during Cyclone Mahasen (May 2013) due to concentration of access.

d) **Satellite Mobile Phone**

Satellite phones are common for a communication mean during disasters in developed countries.   Especially, while mobile phones are disconnected due to concentration of access in disasters, satellite mobile phones can be connected.   Therefore, satellite mobile phones are quite effective during and after disasters for requesting relief when mobile phones are disconnected.   It is also effective for a supplemental system to cover the weakness of mobile phones.   DDM has a plan to install 13 satellite mobile phones.

e) **Short Message Service (SMS)**

Disaster Management Bureau started disseminating early warning messages through Cell Broadcasting for cyclone and flood hazards as an activity under "Digital Bangladesh", which the GoB promotes.   It is covering the Districts of Cox's Bazar and Sirajgonj.   A system to cover the coastal area is currently being developing under the JICA project called "Development of Human Capacity on Operation of Weather Analysis and Forecasting".   With this technology,

it is possible to send early warning messages to millions of subscribers who are at any given time residing within the catchment area of any forthcoming disasters such as cyclones within a few seconds.   However, it is to be noted that not all people can receive the benefit from the system due to the literacy rate.   For example, Union leaders can read the messages, but some Unit leaders cannot.

Director General (DG) of DDM sent SMS message during Cyclone Mahasen (May 2013), and DDM succeeded to shorten time to deliver early warning information.   Thus SMS is effective to disseminate information to many people at once.

(2) HF/VHF wireless system, Siren, Megaphone

a)   HF/VHF

HF/VHF wireless system is a dominant communication system among CPP HQ, Zonal Office, Upazila Office (HF), and Union Office (VHF).   However, this system has not been installed in all of the Unions, and not all of the systems are working.

Some CPP indicated they wanted to install a HF/VHF system in all Unions, but on the other hand, it is better to install walky-talkies, an interactive wireless system, because HF/VHF system requires electricity, is not portable and expensive and difficult to repair.   The system has some weak points, but an interactive system such as HF/VHF is an important item for early warning and disaster information systems.

b)   Siren

Sirens are usually used for signal above 8, and it can disseminate early warning information to wide area with mobile means.   They are common in Bangladesh.   The sound of a siren has effectiveness to make community people recognize a state of emergency, therefore most CPPs emphasize the importance of sirens.   Especially, CPPs require high-power sirens to reach wider areas.

On the other hand, some CPPs reported that sirens could not deliver the content of the information, therefore, megaphones are the better.

Some CPPs have super megaphones in which the sound of siren is set in.   they are effective in terms of sound effect and information dissemination.

In the early warning stage, CPPs use megaphones up to signal 7, and they use sirens for more than signal 8, therefore, installation of high-power megaphone-siren systems is effective for dissemination of information at any signal levels.   It is noted that a consideration be given to the contents mentioned in section "4.1 Department of Disaster Management (DDM), (2) Megaphone-Siren System Installed by DDM".

c) Megaphone

A megaphone is quite simple equipment, and it is effective to disseminate information to wider areas when it is attached to motorbikes, bicycles, vehicles and rikishas. When a megaphone is broken, they can borrow it from rental shops. Megaphones are one of the most important pieces of equipment.

The high-power megaphone-siren system is a fixed system, therefore a mobile megaphone system is quite important in order to supplement the fixed siren system. A portable megaphone is effective in areas with insufficient road networks, on the other hand, vehicle, motorbikes and bicycles with a megaphone are effective in areas with sufficient road networks.

(3) Mosque Microphone, Radio, etc.

a) Mosque Microphone

Most mosques have microphones and the microphones are used every day, therefore there are no problems with maintenance. The microphones are one of the effective pieces of equipment for early warnings. Muslims and non-Muslims live in the same areas, so there is no problem regarding areas. On the other hand, the number of mosques is limited in areas where non-Muslims are dominant in rural areas. Therefore, consideration is to be given regarding in rural areas.

However, most mosques which have microphones are in areas where upper class people live, and mosques which do not have microphones are in areas lower class people live. Also in upper class areas, they give much of their charity to mosques and there is no problem for maintenance, but in lower class areas, there is issue for maintenance.

There are many CPPs where they use mosque microphones for early warning information, but on the other hand, after 8 pm, the last prayer of the day, they said they canno t guarantee they can use mosque microphones. Therefore, there might be some problems for dissemination of information at night.

b) AM/FM Radio, TV

AM radio is covered all over the country, therefore it is effective for information dissemination to wider areas. However, the audience of AM radio is less than 5% and, it is very low.

People can listen to FM radio only in several big cities, and it is not appropriate for information dissemination.

On the other hand, many CPPs reported that portable radios are cheap and, they wanted to have Japanese radios since they are high-quality, long-life and waterproof.

Most people do not have TV except for urban areas, and in coastal areas, especially rural

areas there is almost no electricity.   Therefore, TV is not effective in cyclone prone areas. Disaster information is broadcast on the news, but except for the news, the information is in subtitles.   Therefore, literacy should be considered.   On the other hand, many restaurants and tea shops have TVs, so information can be expected to be disseminated from people who go to restaurants and tea shops.

c)   Community Radio

16 community radios have been established all over the country.   The audience rating is less than 5% in areas without community radio, but it is almost 70% in areas with community radio.   Community radio uses FM, therefore people can listen to the community radio with their mobile phone.   This is one of the reasons why the audience rating is so high in areas with community radio.

However, it is expensive to establish a community radio station, and it requires enormous cost for operation and maintenance.   But if these issues can be solved, community radio is one of the most effective systems for early warning information.   A community radio station is to be established and operated in Upazila Hatia, Noakhali District through a JICA Partnership Program.

Applicability of equipment mentioned above is shown in the following table.

Based on the table, the equipment below is effective for early warning and disaster information system.

- SMS (Mobile phone):   Most residents have a mobile phone, and it is possible to do blanket mailing with SMS.

- Satellite mobile phone: It is possible to implement mobile phones.   And also it's possible to allow interactive communication.

- Fixed speaker-siren system: It is possible to cover remote areas with installation of the system in places such as Char Areas[7].   It's also possible to cover wider areas with high-power siren system.

- Megaphone: Common information system.   It is effective in areas with insufficient road networks.   Also it is possible to supplement fixed speaker-siren systems.

- Megaphone with vehicles, motorbikes, bicycles, etc.:   It is effective in areas with sufficient road networks.   It is also possible to supplement fixed speaker-siren systems.

- AM radio: Cheap, simple and it is possible to deliver information to wider areas.

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[7] Char Area: An island area which is created by accumulation of sediments

Table 4.2   Applicability of Equipment for Early Warning System

Equipment	Applicability							Remarks
	Broadcast	Reachable Distance	Portability	Electric Power Supply	Literacy	Communicability	Price	
Landline	C	C	C	A	A	A	C	
Fax	A	C	C	C	C	A	B	
E-mail	A	B	C-B	B	C	A	B	
Mobilephone	C	B	A	A	A	A	A	
SMS (Mobile phone)	A	B	A	A	C	A	A	
Satellite phone	C	A	A	A	A	A	B	
HF/VHF	A	A	C-B	C	A	A	C	
Fixed Speaker-Siren	A	A	C	C	A	A	C	
Hand Siren	B	B	A	A	A	C	A	
Loud Speaker(Fixed)	A	A	C	C	A	A	C	
Super Megaphone	B	B	B	A	A	A	B	
Megaphone	B	C	A	A	A	A	A	
Megaphone with vehicle, motorcycle, bicycle, rikisha, etc.	B	A	A	A	A	A	A	
Mosque Microphone	B	B	C	B	A	A	C	
TV	A	A	C	C	B	A	C	
FM Radio	A	B	A	A	A	A	A	
AM Radio	A	A	A	A	A	A	A	
Community Radio	A	B	A	A	A	A	C	

Note: Applicability;   A: Good   B: Average   C: Not Good   -: Not applicable

Source: JICA Survey Team

(4) Infrastructures related to Information System

Interview surveys regarding infrastructures related to information systems such as mobile phones, power supply and mosque microphones were conducted.   Outline of the survey is as follows.

a)   Mobile Phone

Mobile phones are becoming common recently, in Bangladesh.   Therefore, mobile phones are one of the most important pieces of equipment for the information system.

In Bangladesh, there are several telecommunication companies.   There are differences in the area covered by each company, and this situation is similar to Japan.

The signal of mobile phones covers almost all target areas, and 80% of the areas are covered based on the survey result.   On the other hand, in Ratandi Taltali Union, Galachipa Upazila, Patuakhali District, signal covers only 30 % of the Union.   Actually, mobile phones are disconnected during the interview survey even in the Union Parisad (UP) Office.

Usually the ownership ratio of mobile phones is proportionate to cover the ratio of mobile

phone signals. However, in some areas, the ownership ratio is quite low although the signal covers wide area. It is considered that income level of the community people and the livelihood condition affects to the situation.

The interview survey was conducted in DMC and CPP to obtain the cover area. The result is shown in Table 4.3. When the answers were completely different, both data are indicated in the table.

b) Power Supply

In Bangladesh, the power supply is quite poor, especially in coastal areas, there is almost no power supply. In average among the coastal areas, only 20 % of each area has electric power. Even if the power is supplied, there is almost no electricity because of power cuts. That means, it is not "power cut" but "power supply" only several hours a day.

In Chittagong, the biggest city in the target area, electricity covers almost 100% of the city, however in most other areas, less than 20 % are covered.

In order to deal with this situation, solar panels have been installed for electric lights in night time and battery charge of mobile phones. Solar panels have been installed not only in areas without electricity but also areas with electricity due to frequent power cuts.

The ownership ratio of solar panels is less than 20 % in the target areas.

The price of a solar panel is 20,000-30,000 BDT, and people can get a loan using micro credit.

c) Mosque Microphone

Mosque microphone is effective equipment except at night, because the imam is not in the mosque at night.

There are many cases of using mosque microphones during cyclone time for early warning. It is very effective for early warning because the mosque microphone is well-managed due to everyday use and the microphone covers wide area.

However, there are almost no mosque microphones in some areas, for example, in Jahaj Mara Union, Hatia Upazila, Noakhali District, no mosques are found in outside of polders. The ownership ratio is almost 60 % on average, and the coverage area is almost 70 % on average.

Infrastructures related to the information system are shown in the following table.

Table 4.3 Actual Conditions of Infrastructures related to Disaster Information System

Equipment / Area	Mobile Phone		Electricity		Mosque Microphone		
	Cover ratio of the area	Ownership ratio (Household)	Commercial Power	Solar System	Number of Mosques	Ownership ratio	Cover ratio of the area
Bagerhat District	60%	80%	15%	5%	3,548	40%	65%
Mongla Upazila	90%	70%	15%	30%	194	33%	50%
Chila Union	45%	35%	0%	70%	21	50%	45%
Sarankhola Upazila	90%	80%	10%	15%	332	33%	50%
Southkhali union	80%	70%	30%	7%	95	35%	25%
Ryanda Union	50%	70%	2%	1%	71	37%	50%
Khulna District	98%	95%	25%	20%	10,859	88%	85%
Koyra Upazila	96%	95%	5%	25%	157	70%	100%
North Bathkashi Union	97%	94%	8%	27%	13	69%	75%
South Bathkashi Union	92%	91%	2%	21%	23	100%	55%
Dacope Upazila	99%	80%	15%	25%	67	67%	70%
Kamarkhola Union	98%	95%	2%	20%	13	65%	50%
Sutarkhali Union	90%	65%	0%	10%	35	60%	55%
Satkhila District	100%	95%	20%	20%	3,296	88%	85%
Shyamnagar Upazila	100%	80%	15%	30%		67%	70%
Gabura Union	98%	90%	0%	50%	25	63%	55%
Padmapkur Union	100%	25%	0%	30%	26	65%	75%
Barguna District	85%	75%	35%	2%	3,485	40%	55%
Barguna Sadar Upazila	100%	90%	50%	30%	966	30%	40%
Naltona union	75%	45%	3%	7%	25/185	14%	39%
Badarkhali union	90%	85%	1%	5%	85	25%	40%
Patharghata Upazila	85%	60%	10%	5%	635	30%	45%
Patharghata sadar union	95%	85%	8%	5%	-	33%	45%
Charduanti union	95%	85%	8%	5%	-	45%	60%
Bhola District	95%	91%	10%	9%	3,083	90%	75%
Charfassion Upazila	90%	90%	3%	35%	1,200	91%	70%
Dar Char Union	100%	85%	0%	18%	13	84%	100%
Char Madraj Union	100%	95%	20%	15%	54	83%	100%
Lalmohan Upazila	95%	93%	5%	25%	721	87%	80%
Lord Harding Union	96%	94%	5%	22%	48	62%	90%
Dholigour Nagar Union	97%	91%	10%	7%	38	75%	80%
Manpura Upazila	85%	90%	1%	45%	200	70%	70%
Manpura Union Parisad	95%	92%	2%	50%	26	77%	65%
Hazirhat Union	85%	90%	1%	50%	55	82%	70%
Patuakhlai District	94%	88%	15%	12%		83%	87%
Galachipa Upazila	85%	80%	7%	18%		73%	75%
Ratandi Taltali Union	30%	30%	0%	80%	85	35%	55%
Amkhola Union	100%	30%	3%	—	130	45%	70%
Kalapara Upazila	100%	80%	12%	25%	65	70%	73%
Lata Chapli Union	100%	70%	9%	-	65	70% (CPP) 90% (DMC	33% (CPP) 100% (DMC
Tiakhali Union	99%	90%	10%	8%	38	91%	95%
Pirojpur District	80%	70%	40%	5%	3,177	50%	55%
Mathbaria Upazila	70%	65%	12%	5%	-	55%	60%
Bethmore Rajpara Union	90%	80%	15%	10%	76	40%	35%
Bara Masua Union	90%	95%	3%	10%	45	22%	30%
Chittagong District	100%	99%	100% (Urban) 40% (Rural) 0% Sandwip	2%	No information		100%
Banshkhali Upazila	100%	70%	60%	2%	520	100%	100%
Baharchhara Union	80%	60%	50%	5%	100	70%	90%
Chhonua Union	100%	80%	10% 7-8 hours/day	10%	35	86%	90%
Sandwip Upazila	100%	90%	5% 3hours/day	50%		90%	80%
Rahmatpur Union	90%	95%	1% less than 4-5hours 10% generator	20%	15	100%	100%
Sharikaito Union	100%	60%	0%	50%	100>	100%	100%

Equipment / Area	Mobile Phone		Electricity		Mosque Microphone		
	Cover ratio of the area	Ownership ratio (Household)	Commercial Power	Solar System	Number of Mosques	Ownership ratio	Cover ratio of the area
Cox's Bazar District	95%	80%	60%	35%	1,834	45%	60%
Kutbudia Upazila	85%	80%	2%	50%	45	60%	55%
Lemshikhali Union	95%	80%	0%	20%	45	50%	40%
Koiybarbill Union	95%	80%	0%	15%	20	65%	45%
Moheshkhali Upazila	90%	60%	40%	5%	435	50%	50%
Kutubjum union	87%	95%	45%	20%	33	50%	45%
Matarbari union	90%	95%	40%	4%	55	45%	55%
Feni District	90%	90%	100% Urban 40% Rural		No information		80% 80-90%
Sonagazi Upazila	100%	80%	60%	10%	700	97%	100%
Char Darbesh Union	100%	70%	20% 8-10hrs	5%	85	88%	100%
Char Chandia Union	100%	50%	50%	5%	87	92%	60%
Lakshmipur District	70%	99%	100% (Urban) 63% (Rural)	1%	3,335	95%	100%
Ramgati Upazila	80% 10% (Char)	50% 1% (Char)	10%	5%	361	98%	100% (Main land) 70% (Char)
Char Alexander Union	70% (CPP) 100% (DMC)	30% (CPP) 100% (DMC)	15% (CPP) 30% (DMC)	20% (CPP) 5% (DMC)	80	88% (CPP)	80% (CPP) 100% (DMC)
Char Abdullah Union	100% (CPP) 50% (DMC)	50% (CPP) 20% (DMC)	0%	2% (CPP) 1% (DMC)	21	24% (CPP)	70% (CPP) 100% (DMC)
Noakhali District	Except 100% Nizhum Dwip		40%	10%	No information		100% (Urban) 50% (Rural)
Subarna Char Upazila	90%	70%	30%	10%		66%	70%
Mohammadpur Union	100%	90%	0%	30%		100%	50-60%
Pobra Char Bata Union	40%	80%	10%	5%		-	70%
Hatia Upazila	40%	45%	2%	10%		60%	25%
Jahaj Mara Union	80%	35%	0%	5%	No Mosques outer polder	80% (Inside of Polders) (Outside of 0% Polders) (CPP)	70%
Nizhum Dwip Union	25%	30% CPP 70% DMC	0%	5%	15	100%	50%

Source: JICA Survey Team

4.4. Information Dissemination Ratio/ Evacuation Ratio

(1) Information Dissemination Ratio

a) CPP Established after Cyclone Aila

The information dissemination ratio is different between CPPs established in the 1970's in the south and south-east areas and CPPs established after Cyclone Aila (May 2009) in the south-west area.

According to the interview survey, the information dissemination ratio was almost 10-20 % during Cyclone Aila (May 2009) because there was no CPP at that time. At the moment, the ratio is around 50%, and with appropriate equipment, it could be 80-90%. Therefore, necessary equipment need to be equipped as well as the capacity enhancement for disaster risk management.

Also in areas CPPs established in the 1970's, almost 80% of equipment is out of order

because it is too old.   Therefore, in both areas an appropriate number of equipment is required to improve the information dissemination ratio.

b)   Issues in Char Areas

Although the information dissemination ratio is almost 100% in the areas where CPPs were established in the 1970's in the South and south-east areas, and the activity for early warning has been effectively conducted.   A problem is that some CPPs report that the information dissemination ratio is about 70-90%, and the rest of 10-30 % is Char Areas where CPPs are unable to deliver information.   No CPPs are assigned in Char Areas.   Therefore, the areas are out of the information network.   The areas also have problems with road network and other infrastructures.   Therefore, it takes longer time for information dissemination or lack of information.

Usually there are 10-20,000 people living in one Char Area.

In "Char Development and Settlement Project (CDSP) (1992-2016)" assisted by Netherland and International Fund for Agricultural Development (IFAD), they have given a land of 1.5 acre and family registers to people who live there about 10 years.

In the newly formed communities, there are no Units and CPPs have been established. Also the areas are out of polders, this means there are no polders, no cyclone shelters, and no schools which could be used for cyclone shelters.

For example, few people died in Noakhali District in Cyclones Sidr (November 2007) and Aila (May 2009).   However, the deaths were residents in the Char Areas, and they died on the way to cyclone shelters inside of a polder.

People living in Char Areas are afraid of losing their land, so they refuse to evacuate, or they do not evacuate until the water level rises, then finally it is too late to evacuate.

Some DCs have a view that they would like to use effective early warning to improve the evacuation rate of the people in the Char Area, not by constructing cyclone shelters because if they construct cyclone shelters outside of polders, that means they accept certain people will live in areas that are not approved.

When people in Char Areas desire to have CPP, the following procedure has to be taken.

There are two (2) committees, the policy formulation committee which is chaired by the minister of MoDMR and the executive committee which is chaired by the head of CPP secretariat.   When a new CPP is established, a written request is to be submitted to the policy formulation committee.   After the request is approved, it is sent to the executive committee. A new CPP is established after approval by the executive committee.

It will take time for the new CPP establishment and establishment of an early warning information dissemination system. Therefore, before the system is established, it will be effective to locate fixed speaker-siren system in the areas.

c) Isolated Areas

It is also difficult to disseminate early warning information to isolated areas even inside of polders, and this isolation affects the information dissemination ratio. Moreover, most road networks are inadequate in isolated areas, therefore, it is very difficult to access the areas by vehicle, and only motorbikes, bicycles or small boats.

d) Early Warning Dissemination to Fishermen

Fishing is done in rivers, coastal areas and deep-sea. Out of these fishing places, it is very difficult to disseminate early warning to fishing boats that go to deep-sea area 50-200km far away from coast.

According to the information from DDM, 25% of deaths were fishermen during Cyclone Aila (May, 2009). They could not be communicated in deep-sea, and then they were hit directly by the cyclone.

Even if fishermen have mobile phones and radios, it is impossible to communicate from deep-sea because the signal areas is very limited.

Satellite mobile phones are very effective for fishermen in the deep-sea area, but the issue is the number of equipment to be provided.

It is necessary to consider an effective early warning system for fishermen. At the moment some of CPPs have a plan to install light houses for early warning.

According to CPP HQ, they disseminated early warning information earlier than before to fishermen, and there were no deaths during Cyclone Mahasen (May 2013).

e) Setting of Adequate Lead Time and Shortening of Information Dissemination Time

The information dissemination ratio has a direct relation with lead time for early warning. With enough lead time, the information dissemination ratio should rise, but without enough lead time, the ratio will probably fall. In the SOD, the lead time of warning signals is set as below.

(a) Warning   24 hours before

(b) Danger   At least 18 hours before

(c) Great Danger   At least 10 hours before

During Cyclone Aila (May 2009), the lead time was shorter than the time cited above, and this caused more damage.

According to the SOD, during great danger, BMD should issue warnings at least 10 hours

before for the signal recognized as "Great Danger".   Based on the results of the survey, most of CPPs reported it took 5-6 hours to disseminate warnings to community people.   Therefore, a lead time of 10 hours is adequate for warning dissemination.

However, the data above does not include char or other areas.   In order to disseminate warnings to char and isolated areas, the lead time should be longer or the rate of warning dissemination should be shortened.

During Cyclone Mahasen (May 2013), the number of deaths was 17, and this was a result of taking lead time.   Most CPP officials reported the ratio of warning dissemination was almost 100%.

However, as per during Cyclone Aila (May 2009), the warning level was suddenly changed during the night time, and it was impossible to obtain 10-hour lead time.   Therefore, it is realistic to consider a system to disseminate warnings to community people as soon as possible including Char and isolated areas.

(2) Evacuation Ratio

According to the interview survey, evacuation ratios vary.

In urban areas, there are many concrete buildings and they are used as cyclone centers in disaster times.   Also people want to evacuate to more comfortable places such as their relative's and friend's houses than cyclone shelters.   Actually, people who need to evacuate are mainly living along rivers and in farming villages where there are no concrete buildings.

For example, during Cyclone Aila (May 2009), people evacuated earlier based on the experience of Cyclone Sidr (November 2007).   Thus the evacuation ratio has been improved. Also during Cyclone Mahasen (May 2013), CPP reported that the evacuation ratio was more than 80 % in some of the survey areas.

(3) Emergency Relief Information

Mobile phones are mainly used for communication to request of emergency relief.   The information flow begins with Union Parisad (UP Chairman) to Upazila Nirbahi Officer (UNO). The information is disseminated to Deputy Commissioner (DC).

At the same time, an emergency situation report and application for request of emergency relief materials are prepared.   However, there is no fax in Union level, therefore the UP Chairman sends them to UNO by mail.

There used to be an HF wireless system from DDM HQ up to Upazila level before 2008, but at the moment, this system is not working.   Therefore, at the moment mobile phones are

the only communication tool for emergency relief information. Mobile phones are vulnerable during and after disasters. Satellite mobile phones are considered as a representative supplemental system, but there is a problem with operation and maintenance in rural areas.

4.5. Issues of Early Warning and Disaster Information System

(1) Issues of Early Warning and Disaster Information System

a) Current Status of Early Warning System

There are several lines of early warning dissemination in Bangladesh such as DDM line (a line through DDM, DMIC and DMC (from the central government to the local government)), early warning dissemination through CPP (from CPP HQ to CPPs at local level using in early warning system) (hereinafter called the CPP line) and media such as TV and radio. At the moment the CPP line has played the main role in the early warning system.

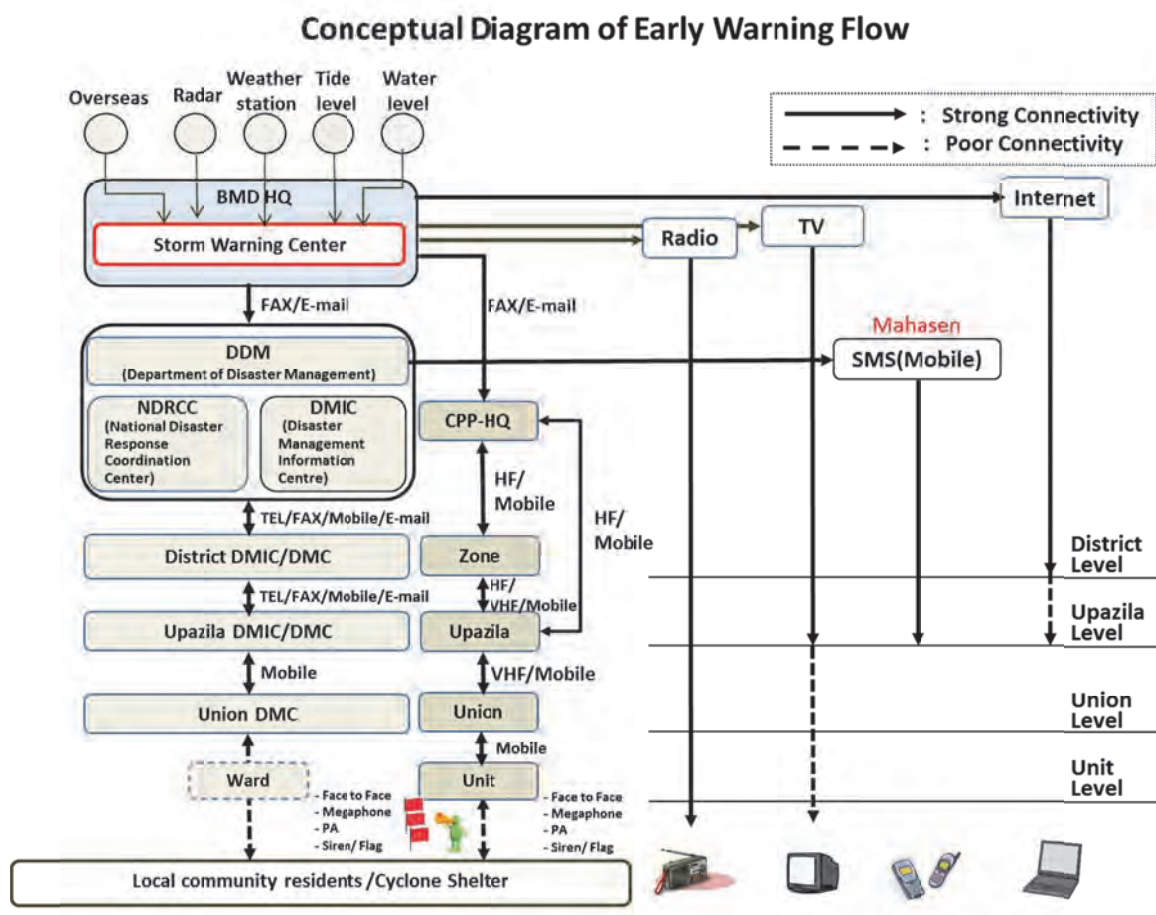A conceptual diagram of early warning information flow in Bangladesh is shown in the figure below.

Source: JICA Survey Team

Figure 4.1   Conceptual Diagram of Early Warning Information Flow

b) Inter-Regional Discrepancy and Digital Divide

The inter-regional discrepancy and the digital divide affect warning dissemination to community people.

People living in urban areas or local cities can acquire cyclone information easily through various media, such as internet, mobile phone, TV and radio. On the other hand, it is very difficult for people who live in farming villages, fishing villages, and rural areas to acquire cyclone information.

Therefore, it is important to disseminate information to the people living in rural areas and isolated areas where information networks and road networks are inadequate.

Information acquisition method is shown in the table below.

Table 4.4 Information Acquisition Method and Inter-Regional Discrepancy

Residence area	Internet	TV	Community radio	Mobile phone	Radio	Fixed Speaker and siren	Condition of Power Supply
Urban area	○	○	○	○	○	△	Frequently
Local Cities	△	△	△	○	○	○	-power supply only sometimes -Use of solar panel
Farming/fishing village	—	—	—	△	△	○	-Almost no power supply -Use of solar panel
Rural areas/ Isolated areas	—	—	—	—	—	○	-No power supply
			Local cities 15-20km				

Source： JICA Survey team   ○：Main method   △：Sub method   －：Impossible

c) Issues of Early Warning and Disaster Informaiton System

The following four (4) concepts are very important for proper work of early warning and evacuation at early stage safely.

[Rapidity]: early warning is disseminated to community people as soon as possible

[Accuracy]: improvement of accuracy is needed

[Dissemination]: information is disseminated even under network problem during disasters

[Persuasive]: disseminated information is persuasive enough to evacuate

Based on the concepts explained in the above, issues of early warning and disaster information system are summarized in the table below.

Table 4.5   Issues and Recommendations of Early Warning and Disaster Information System

Concept	Issues	Recommendation
Rapidity	• It takes 6 hours on average for information dissemination in the DDM line. It takes 2 hours on average for information dissemination in the CPP line.	• Reduction of time by communicating with Upazila level directly. Review of administrative work (use of SMS and capacity enhancement of disaster risk management).
	• Inadequate number of equipment in CPPs causes delay on disaster information dissemination below Upazila.	• Acquisition of equipment for information dissemination (Megaphone, vehicle with megaphone etc.)
	• Inadequate road network causes delay on disaster information dissemination.	• Development of road networks
	• Isolated areas including Char Area needs extra time for information dissemination than other areas.	• Development of a system which can cover isolates areas. Development of road networks (installment of remote control speaker/siren system)
Accuracy	• Necessity of evacuation is decided only by cyclone information from BMD/SWC	• Introduction of other information source for example, addition of water level observation data
	• Accuracy of prediction of the cyclone center made by BMD is 100 km for 10 hours. This also means there is inaccuracy in timing.	• Enhancement capacity of BMD to improve accuracy of information.
Dissemination	• Power supply is unstable. Communication means such as fax, HF/VHF, wireless and TV is dependent on power supply.	• Installment of communication means which are independent from power supply. Installment of communication means with back-up such as solar power and remote control speaker/siren system.
	• Network of cell phones do not cover all of cyclone vulnerable areas, so the dissemination rate is dependent on the cover area. A network problem is often seen during disasters. There is a possibility of fall down of towers due to strong wind.	• Installation of a system which is independent of issues mentioned on the left.
	• Inadequate number of equipment affects information dissemination as seen in	• Development of information dissemination equipment (installment of

	example of CPP.	megaphones)
	• Inadequate road network affects information dissemination	• Development of traffic infrastructure (development of road network, vehicle, motorbikes, motorboat etc.)
	• Isolated areas including Char Area have disadvantage on receiving information due to lack of transportation means	• Installment of new systems such as remote control speaker/siren system, traffic infrastructure, transportation means vehicle, motorbikes, motorboat etc.
persuasive	• Persuasive has close relationship with accuracy. Persuasive is dependent on accurate information of cyclones	• Improvement of accuracy of information announced by BMD/SWC(Capacity enhancement of BMD)
	• Some people do not evacuate even if they hear warnings. The level of persuasive is not enough to make them evacuate. Disaster risk management education and evacuation drills are needed.	• Capacity enhancement through disaster risk management education and evacuation drills. They will help to improve the situation.
	• Un-development of hazard maps affects persuasive since hazard maps show high risk areas and evacuation site visually.	• Development of hazard maps
	• Disaster risk management plan is not formulated. If the plan is formulated, it does not match to the real situation.	• Formulation of disaster risk management plan

Source: JICA Survey Team

A conceptual diagram of issues of Disaster Information System in EWS is shown in Figure 4.2.
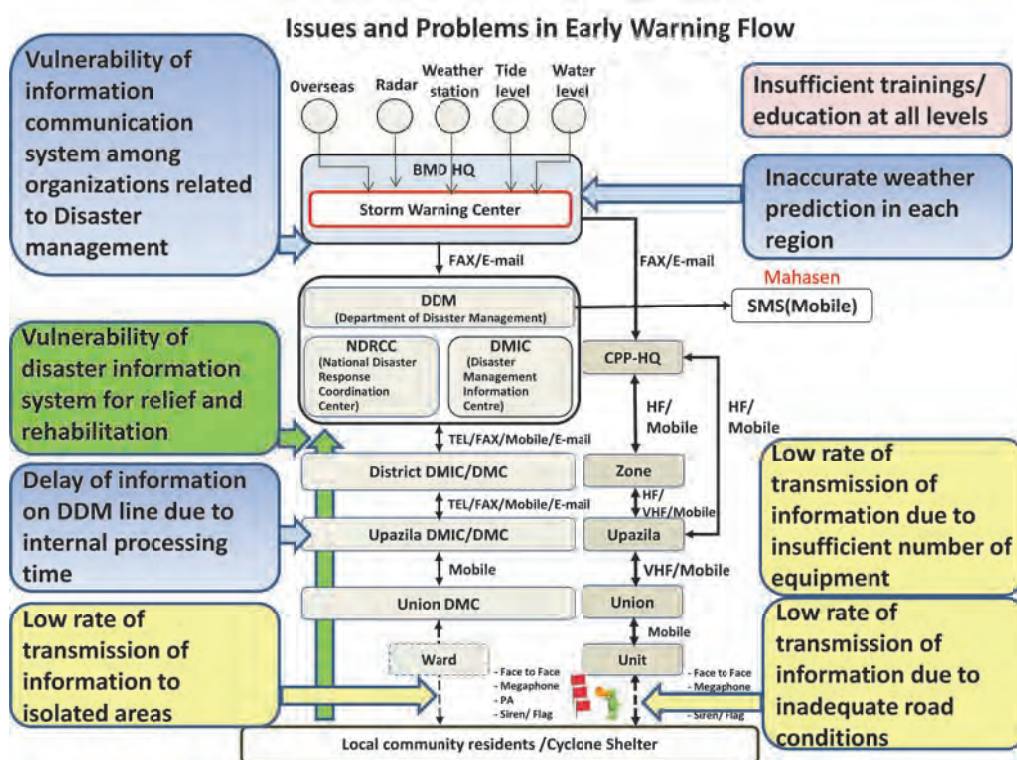
Source: JICA Survey Team

Figure 4.2   Issues of Disaster Information System

(2) Possible Countermeasures for Issues of Disaster Information System

Countermeasures are proposed for Early Warning System (EWS) and disaster information system from the perspective of necessary equipment for the systems below.   These two systems function by complementing each other.

a)   Countermeasures for Early Warning System

i)   Remote Control Speaker-Siren System

This system uses Remote Amplifier Activation via AM/FM broadcasting radio by using Dual Tone Multi-Frequency (DTMF) is effective for the system.   DTMF is a line for touchtone phones.   It is also called "tone signal".   By using this system, cyclone information from a control center can be transmitted to residents directly without a time lag.   The system can be operated from a center located at a distance of 100 to 200 km.

Moreover, the system can transmit different messages to each district.   Also this system can be remote-controlled, even when the warning signal level is high such as signal 8. Therefore, using this system, volunteers can avoid walking in heavy rains to transmit information to community level.

By installing this system in isolated areas such as Char Areas, issues such as inadequate number of equipment, road network, inadequate information network can be solved.

A conceptual diagram is shown below.
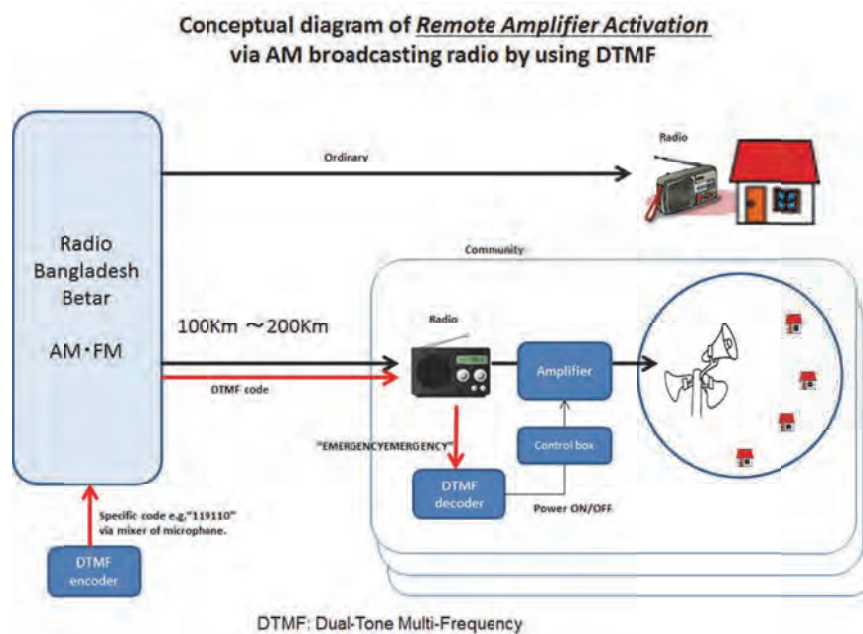
Source: JICA Survey Team

Figure 4.3   Remote Amplifier Activation via AM/FM Broadcasting Radio using DTMF

ii)   Mobile Speaker

This equipment has two speakers that are set on a motorbike, vehicle, bicycle rikisha etc., in order to disseminate warnings to wider areas. It covers lack of equipment. It is also effective to disseminate warning to community people at the last minute. Moreover, it is possible to use these vehicles for transfer of urgent relief information after a disaster. Motorbikes are recommended in areas with inadequate road networks, usually below Union level. In areas with adequate road network usually Upazila level, all vehicles can utilized. The precondition of installing this system is procurement of motorbikes, vehicles, etc..
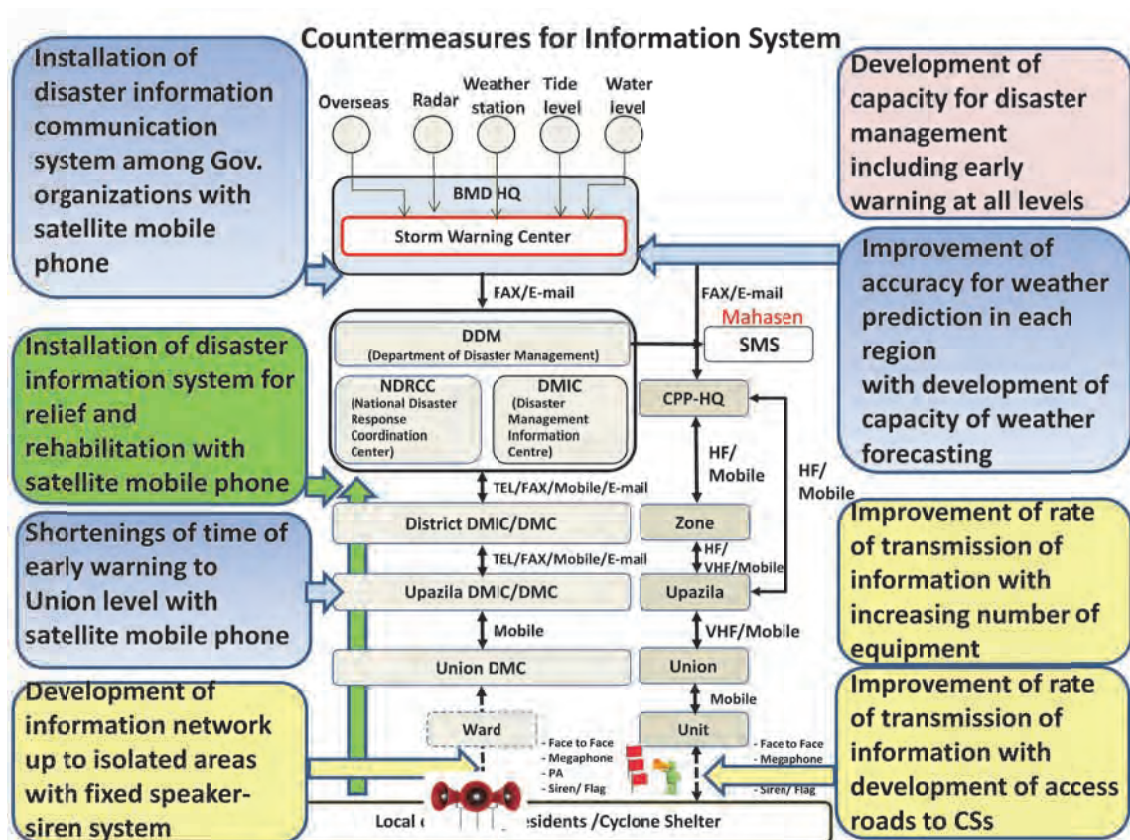
Source: JICA Survey Team

Figure 4.4   Countermeasures for Issues of Disaster Information System

Up to here, improvement of disaster information system was the focus of discussion. However, the final objective is evacuation of people.   Awareness is getting high due to repeated cyclone, but education and evacuation drills are needed.   Detail is to be discussed in section "6.1 Community Based Disaster Risk Management (CBDRM)".

b)   Countermeasures for Disaster Information System

Mobile phones usually have a network problem at the time of disasters.   For example, cell phones were disconnected in some areas for three (3) days during and after disasters in the past.

Satellite Mobile phones are effective in and after a disaster, by using Satellite mobile phones, emergency relief information can be transmitted to upper level, and it can be useful for early assistance for disaster and relief.   This system can be used for communication from HQ to Union level (HQ $\Leftrightarrow$ District (Zone) $\Leftrightarrow$ Upazila $\Leftrightarrow$ Union).

By establishing an information system utilizing satellite mobile phones among government organizations related to disaster risk management, it will be possible to communicate among these organizations in not only during cyclones but also national catastrophes.

This system can provide communication between the central government and Districts by

constructing a satellite mobile phone transfer system to deal with the disasters.

5.   Cyclone Shelters

5.1.   Capacity of Cyclone Shelters

The number of cyclone shelters is insufficient in all target areas at present, and the capacity of cyclone shelters is less than 10% of the total population.   Meanwhile, concrete buildings are common in urban areas, and the situation is completely different to that of rural areas.   It was not necessary to evacuate in the urban areas in Upazila Ramgati, Lakshmipur District when Cyclone Aila (May 2009) hit the area, therefore, the evacuation rate was around 5%.   The content of 5% was residents who lived along the river and did not reside concrete buildings.

At rural area, Union Char Abdullah, Upazila Ramgati, Lakshmipur District, there is only one (1) cyclone shelter for the population of 32,000.   Therefore, this area could be seriously damaged by a cyclone.   There are many dangerous areas located in Char Areas and isolated areas.

The capacity for accommodation of cyclone shelters in target areas is shown in Table 5.1. The capacity for accommodation is 9.5 % (capacity for accommodation/ total population) in average of each district.   However this figure is not accurate because the number of buildings which can accommodate evacuees in urban areas is not included.   In Chittagong District, some interviews were given to local government officials to know the number of people who can evacuate to safe buildings in urban areas.   The number did not affect the capacity for accommodation of cyclone shelters.   However, the number of people who need evacuation should be surveyed and evacuation plans should be prepared for each cyclone shelter.

Table 5.1 Capacity of Accommodation of Cyclone Shelters

Area	Number of CSs	Capacity		Population	Population Ratio (Capacity/ Population)
Bagerhat District	201	185,155	(Total)	1,597,554	11.6%
Mongla Upazila	35	27,100	(Total)	96,751	28.0%
Chila Union	6	2,100	(Total)	20,973	10.0%
Sarankhola Upazila	76	45,600	(Total)	128,000	35.6%
Southkhali Union	23	11,000	(Total)	29,100	37.8%
Ryanda Union	21	12,000	(Total)	38,997	30.8%
Khulna District	126	740,000	(Total)	2,318,527	31.9%
Koyra Upazila	47	14,000	(Total)	193,391	7.2%
North Bathkashi Union	3	1,000	(Total)	14,431	6.9%
South Bathkashi Union	7	1,500	(Total)	27,000	5.6%
Dacope Upazila	58	29,000	(Total)	152,316	19.0%
Kamarkhola Union	5	1,450	(Total)	14,407	10.1%
Sutarkhali Union	8	2,500	(Total)	37,611	6.6%
Satkhila District	157	62,000	(Total)	1,985,959	3.1%
Shyamnagar Upazila	39	17,000	(Total)	318,254	5.3%
Gabura Union	6	1,900	(Total)	38,825	4.9%
Padmapkur Union	4	1,200	(Total)	26,447	4.5%
Barguna District	234	87,994	(Total)	892,781	9.9%
Barguna Sadar Upazila	75	22,500	(Total)	261,343	8.6%
Naltona Union	6	3,000	(Total)	40,000	7.5%
Badarkhali Union	5	2,100	(Total)	30,000	7.0%
Patharghata Upazila	87	30,000	(Total)	163,927	18.3%
Patharghata sadar Union	10	3,800	(Total)	40,000	9.5%
Charduanti Union	10	4,400	(Total)	31,598	13.9%
Bhola District	506	151,800	(Total)	1,776,795	8.5%
Charfassion Upazila	102	25,500	(Total)	456,437	5.6%
Dar Char Union	7	1,500	(Total)	22,000	6.8%
Char Madraj Union	3	900	(Total)	35,000	2.6%
Lalmohan Upazila	124	31,500	(Total)	283,889	11.1%
Lord Harding Union	7	1,750	(Total)	35,000	5.0%
Dholigour Nagar Unnion	23	7000	(Total)	51,750	13.5%
Manpura Upazila	23	9,000	(Total)	76,582	11.8%
Manpura Union Parisad	5	1,500	(Total)	20,000	7.5%
Hazirhat Union	8	3,500	(Total)	21,000	16.7%
Patuakhlai District	322	350	/CS	1,596,222	7.1%
Galachipa Upazila	30	350	/CS	361,518	2.9%
Ratandi Taltali Union	3	1,200	(Total)	22,587	5.3%
Amkhola Union	3	1,300	(Total)	30,616	4.2%
Kalapara Upazila	105	40,000	(Total)	237,831	16.8%
Lata Chapli Union	7	3,000	(Total)	25,241	11.9%
Tiakhali Union	3	900	(Total)	14,240	6.3%
Pirojpur District	131	25,400	(Total)	1,305,202	1.9%
Mathbaria Upazila	33	15,000	(Total)	351,918	4.3%
Baramasua Union	6	2,300	(Total)	14,550	15.8%
Bethmore Rajpara Union	3	1,350	(Total)	16,720	8.1%

| Area	Number of CSs	Capacity	Population	Population Ratio (Capacity/ Population)
Chittagong District	479	452,880 (Total)	7,913,365	5.7%
Banshkhali Upazila	116	81,200 (Total)	431,162	18.8%
Baharchhara Union	20	10,000 (Total)	33,763	29.6%
Chhonua Union	15	3,000 (Total)	28,748	10.4%
Sandwip Upazila	103	51,500 (Total)	278,605	18.5%
Rahmatpur Union	12	800 (Total)	8,088	9.9%
Sharikaito Union	18	7,200 (Total)	24,543	29.3%
Cox's Bazar District	534	515,683 (Total)	2,381,816	21.7%
Kutbudia Upazila	71	70,500 (Total)	130,108	54.2%
Lemshikhali Union	14	5,950 (Total)	42,700	13.9%
Koiyarbill Union	17	7,650 (Total)	19,128	40.0%
Moheshkhali Upazila	84	31,120 (Total)	333,819	9.3%
Matarbari Union	10	2,500 (Total)	60,000	4.2%
Kutubjum Union	11	2,500 (Total)	30,637	8.2%
Feni District	73	70,000 (Total)	1,496,138	4.7%
Sonagazi Upazila	43	51,000 (Total)	254,974	20.0%
Char Darbesh Union	2	2,000 (Total)	32,145	6.2%
Char Chandia Union	9	2,000 (Total)	40,592	4.9%
Lakshmipur District	100	500 /CS	1,729,188	2.9%
Ramgati Upazila	33	16,500 (Total)	229,153	7.2%
Char Alexander Union	7	2,100 (Total)	40,735	5.2%
Char Abdullah Union	1	500 (Total)	18,791	2.7%
Noakhali District	240	170,800 (Total)	3,108,083	5.5%
Subarna Char Upazila	75	38,500 (Total)	192,003	20.1%
Mohammadpur Union	7	4,000 (Total)	29,738	13.5%
Pobra Char Bata Union	14	7,500 (Total)	35,274	21.3%
Hatia Upazila	97	67,900 (Total)	348,653	19.5%
Jahaj Mara Union	7	8,000 (Total)	125,000	2.4%
Nizhum Dwip Union	8	4,000 (Total)	18,000	16.7%

Source: JICA Survey Team

The number of cyclone shelters and distribution of cyclone shelters are shown in Figures 5.1 and 5.2. The number of cyclone shelters in survey areas is based on the interview survey, and number of cyclone shelters in other areas is based on the data of DDM.

There are many cyclone shelters in the Barisal and the Chittagong Divisions where cyclones hit frequently, on the other hand, there are not so many cyclone shelters in Khulna. Because there has not been so much damage by cyclones in the northern part of Khulna, also there are not so many cyclone shelters in areas with little damage by cyclones. On the other hand, Khulna has a small population, therefore the percentage of capacity for accommodation of cyclone shelters to total population is relatively high. The percentage of capacity of accommodation of cyclone shelters to total population is less than 20 % in the survey areas, and areas of less than one (1) % are concentrated in the northern part of Khulna and the eastern part of Chittagong, because eastern part of Chittagong is a hilly area.
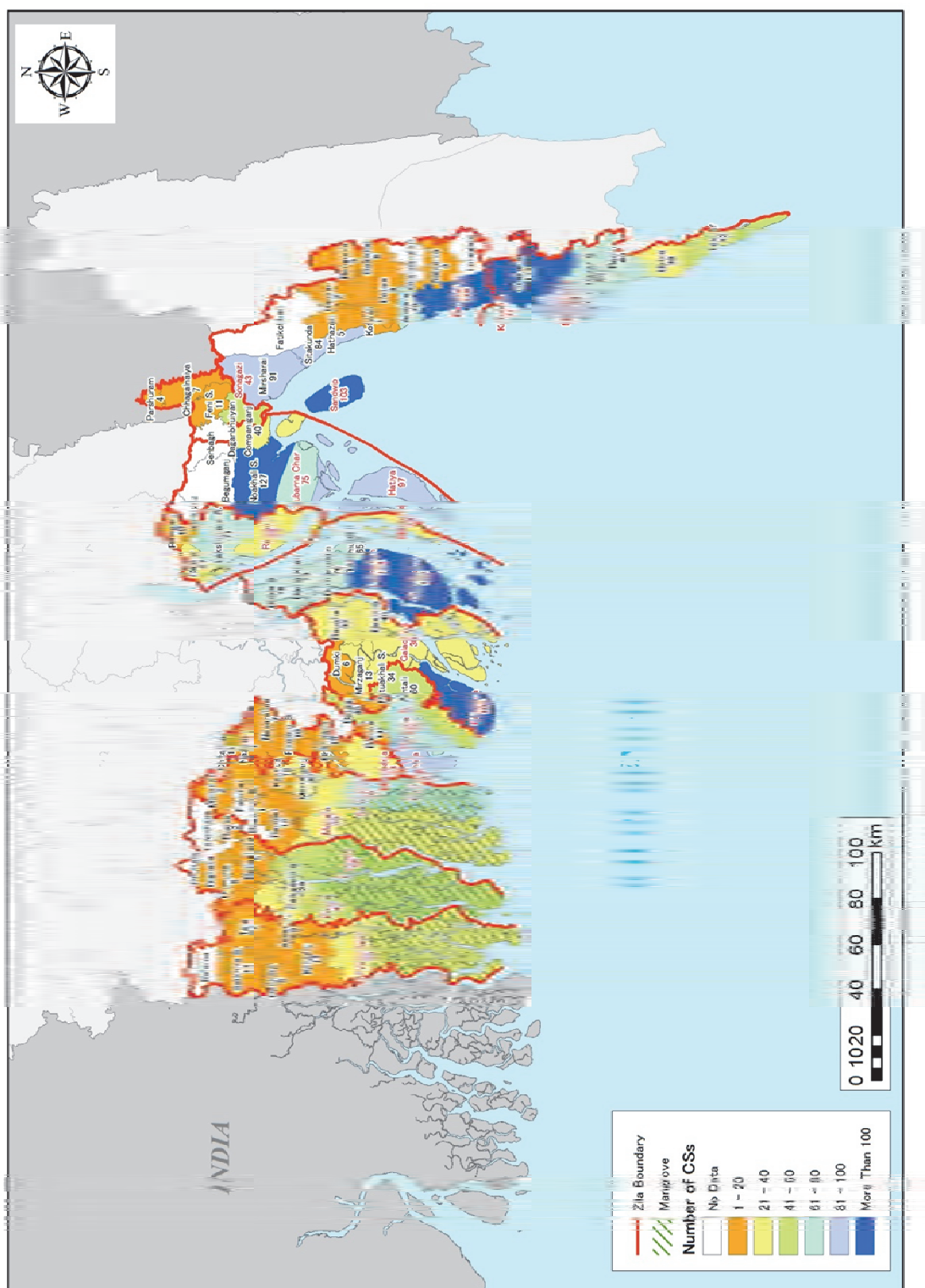
Source: JICA Survey Team

Figure 5.1   Distribution of Cyclone Shelter
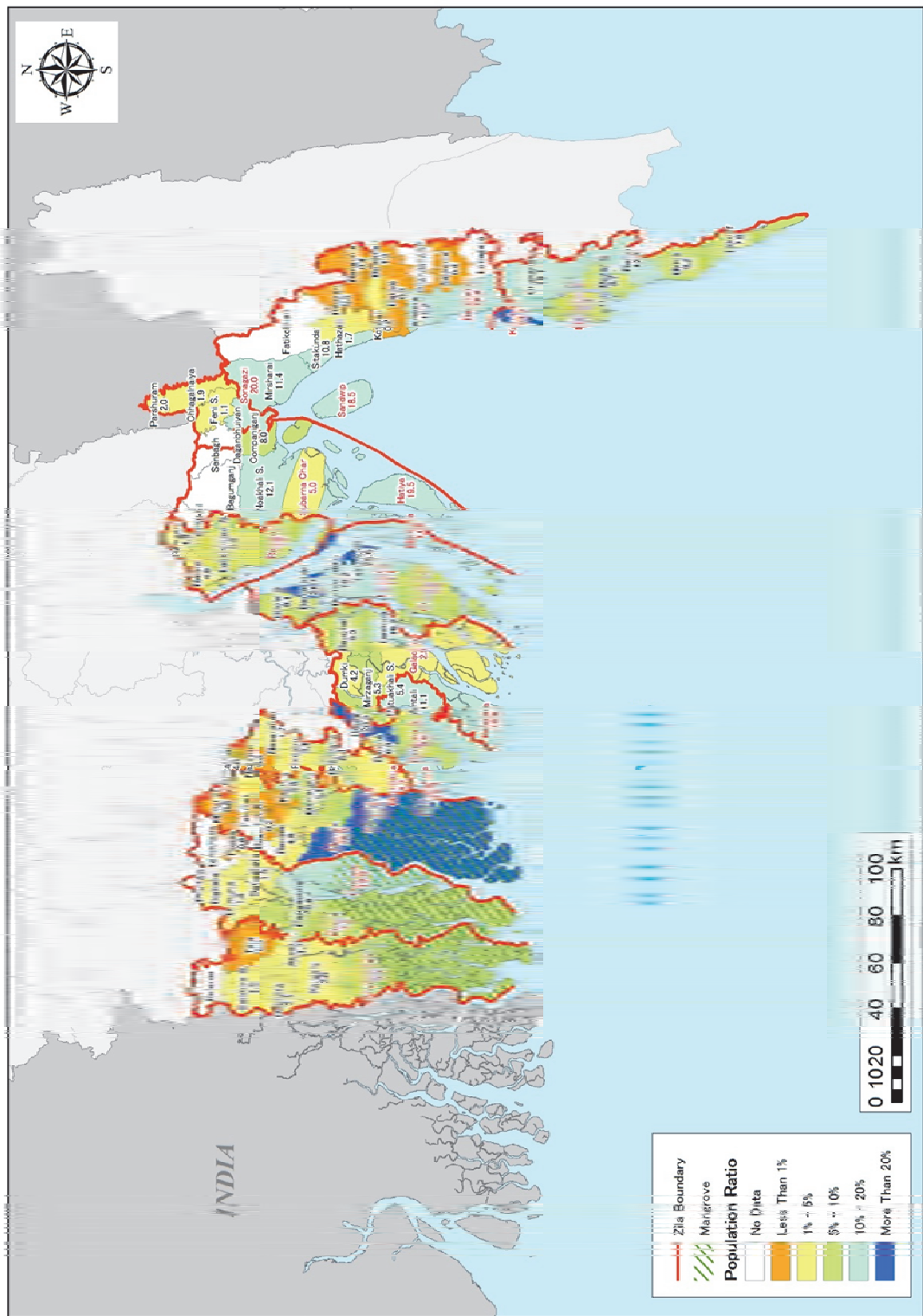
Source: JICA Survey Team

Figure 5.2   Percentage of Capacity for Accommodation of Cyclone Shelters

5.2. Problems with Cyclone Shelters Seen from Survey Result at Community Level

About 40% of evacuees evacuated to cyclone shelters according to the result of the community questionnaire survey, but community people also see many problems with cyclone shelters. A major problem is the access to cyclone shelters. The mean time to the nearest cyclone shelters is 26 minutes normally. However, when a cyclone hits, the road condition becomes very hard to travel on. Therefore, it will take much more time to reach cyclone shelters when an evacuation is needed.

Focusing on the condition of cyclone shelters, all respondents answered there are problems with them. The major problems heard from the respondents are as follows;

-Lack of sanitation (about 80%)

-Not enough space (about 70%)

-No separate space for women (about 60%)

-Lack of water (about 60%)

-Lack of maintenance of cyclone shelters (about 60%)

A gender issue is also present. Although the percentage is low (about 10%), some of them think cyclone shelters are not safe for women so that they cannot take their wives to cyclone shelters or women cannot go to cyclone shelters without their husbands. When the survey team visited cyclone shelters, the number of cyclone shelters with separated sanitation facilities was very low.

These conditions may be affecting the evacuation percentage. If maintenance systems of both normal times and emergency times are established, it will contribute to increase the evacuation percentage.

5.3. Facilities and Equipment

There are many overage cyclone shelters which need to be rehabilitated or have already been abandoned. Although the cyclone shelters built after Cyclone Aila (May 2009) are generally equipped with sanitation facilities such as toilets, those built before Cyclone Aila (May 2009) are mostly not. Even if cyclone shelters built before Cyclone Aila (May 2009) are equipped with toilets, they are on the ground floor and it would be almost impossible to use them for an emergency.

Some cyclone shelters have hand-pumps on the second floor to serve drinking water for evacuees. However, almost all the pumps visited are inoperable and new pumps are located on the first floor. Therefore, there are few cyclone shelters which can serve drinking water in an emergency.

It was found that most cyclone shelters in rural areas do not have any power sources. Although some cyclone shelters have a solar power system, some of often break down within a year after installation.

Foods, drinking water and medicine are normally not stored in cyclone shelters. The Union chairman is to prepare them making a request to UNO or DC as the need arises. As communication equipment is generally not installed in cyclone shelters, chairmen request emergency assistance by mobile phones.

Exceptionally, the cyclone shelter built by Swiss Agency for Development and Cooperation (SDC) in 2012 in Union Royenda, Upazila Sarankhola, Bagerhat District meets the above-mentioned requirements for a cyclone shelter. The cyclone shelter is a three-storied building with the Pilotis structure on the ground floor. The second floor functions as a Killa so that livestock can be evacuated to it. The third floor is designed for meeting rooms, and the room rental for seminars or some events should cover the maintenance costs for the cyclone shelter. Moreover, on the third floor, the cyclone shelter is equipped with toilets separate for men and women, a water tank, a power source (generator and battery), and transmission equipment. Other than those, there is a food stockpile storage on the second floor, and another water tank and a speaker on the roof terrace. Thus the cyclone shelter meets almost all the requirements for a cyclone shelter.

In a similar trial, another cyclone shelter was built in Union Nizhum Dwip, Upazila Hatia, Noakhali District in 2004 under "Char Development Settlement Project II (CDSP II)". The cyclone shelter is used as a guest house for guests from outside this island, and the accommodation fee is to cover the maintenance costs for the cyclone shelter. The cyclone shelter has a toilet on the second floor, a well equipped with a motor pump and a solar panel on the ground floor. However there is no stock of food and water. Water is to be stored in the tank installed on the roof terrace as the warning signal level becomes higher.

The above two examples of cyclone shelters, which are well managed without financial support for O&M costs, seem to be good practices for construction of cyclone shelters.

In the Noakhali District, there are some cyclone shelters constructed by Japan's Grant Aid and constructed by the GoB side by side. Cyclone shelters constructed by Japan have enough height for the highest water level, and sufficient construction. On the other hand, cyclone shelters constructed by the GoB do not have enough height for the highest water level. A member of DMC said that due to shortage of budget, they constructed the cyclone shelter even though they knew the Japanese cyclone shelters were superior.

5.4.   Operation and Maintenance

Most cyclone shelters are ordinarily used for schools, and then the School Management Committee (SMC) maintains them.   However, there is no budget for operation and maintenance, and therefore, it affects the proper operation and maintenance of cyclone shelters. When an alert exceeds level 4, the cyclone shelters are to be unlocked and roles of the maintenance transferred to CPP or DMC from SMC

Although the manner of cyclone shelter maintenance is planned to be similar in the Barguna District and the area where CPP has been newly established (Bagerhat District), SMC maintains the school even in case of a cyclone.

On the other hand, cyclone shelters originally owned by the Red Crescent Society are maintained by CPP or the Red Crescent Society.   Trouble has never occured to any cyclone shelters maintained by both organizations, for example, the trouble is that the key of cyclone shelter does not open the door in case of an emergency.

Two primary schools/mosques/cyclone shelters constructed by Saudi Arabia in Union Jahaj Mara, Upazila Hatia, Noakhali District refused to accept evacuees in the event of Cyclone Aila (May 2009). As CPP has not had any discussions with the school side since then, the current situation related to these schools seems to be unchanged.

Concerning databases or maps of cyclone shelters in Bagerhat, Khulna, Satkhira, Barguna and Pirojpur Districts are available to be downloaded from DMIC's website.   However, all information of cyclone shelters is not necessarily contained in the database.   Although some PIO have made cyclone shelter lists, it is not so common.   For management of DMIC or DDM, it is necessary to make a cyclone shelter database covering all cyclone shelters in cyclone-prone areas and to update the data. And furthermore, it is needed to distinguish the areas where there are no or insufficient cyclone shelters, which is a highest priority work.

Even if a certain organization among SMC, CPP and DMC is in charge of cyclone sehlter management, no organization can properly perform its duty due to lack of budget.   It is desired to earn cyclone shelter maintenance costs by on its own like the above mentioned efforts.

■   Cyclone Shelter Construction, Maintenance and Management Guide 2011

"Cyclone Shelter Construction, Maintenance and Management Guide 2011" is prepared by DDM, in the guideline countermeasures for the issues described above are mentioned below.

- Facilities: separate toilet facilities for women, safe drinking water, food, sanitation and sufficient light, ground floor for cattle as killas

- Construction: "Union based Inundation Risk Map" for height of cyclone shelters and "Bangladesh national Building Code" have to be followed

- Access road: the approach road to the shelters must be useable and, in addition to the main road, be linked with all the roads of the catchment areas.

- Maintenance and Management: The local beneficiary communities have to be involved at the time of construction of the shelters so that later they can take the responsibility of its management.
  If the organization constructing the multi-purpose cyclone shelter is its user, then the responsibility of the management of the shelter will also fall on them.
  The responsibility of management of the multi-purpose cyclone shelters in educational institutions will fall on the relevant management committee of the governance body of the institutions under the control of the Ministries of Education and Primary and Mass Education.
  If the organization/institution constructing the cyclone shelter surrenders its ownership after the construction, in that case the ownership will be entrusted to the Disaster Management and Relief Division.

- List of cyclone shelters: The concerned Upazila Nirbahi Officer will identify, earmark and declare all Government, Non-Government, privately owned commercial buildings as "cyclone shelter" which are considered suitable for use as shelters. He will maintain a list of all such buildings and send a copy of the list to the concerned Deputy Commissioner.
  The Deputy Commissioner will send the list of the cyclone shelters and all other information related to overall management to the relevant Ministries and the Disaster Management and Relief Division on a regular basis.

If the guideline is followed, major issues on cyclone shelters will be solved. However, a comprehensive development plan for cyclone shelters is not mentioned in the guideline. It is recommended to be added or considered.

6. Other Issues related to Disaster Risk Management

6.1. Community Based Disaster Risk Management (CBDRM)

(1) Awareness

The result of the survey at community level shows that there are many community people who tend to think "the weather condition will be better soon" although a relatively strong signal is issued. Many people wait until the last minute to evacuate, and eventually there is a huge time lag between warning delivery and actual evacuation behavior. Inaccurate warning in the past could be a reason behind the behavior. The inaccurate warning caused severe damage in Cyclone Sidr (November 2007) as a consequence. After the tragic experience, there was a tendency that evacuation was taken place smoother at the time of Cyclone Aila (May 2009).

In this respect, it can be said that the level of awareness is getting higher. Data gotten through an interview says about 85% of the people evacuated at the time of Cyclone Mahasen

(May 2013) in Chittagong.   Some respondents answered they expected to take training on disaster risk management, and have equipment for early warning and receive training for community volunteers as their expectation for assistance from outside.   However it is noted that there is always room for improvement.   Some community people who waited until the last minute to evacuate eventually evacuated to house tops or tree tops since they did not have enough time to evacuate to safe places.   Focus should be given to how and when they should evacuate to other areas safely to improve the situation.

(2) Education and Exercises

Levels of education and exercise are not adequate.   About half of the respondents of the community questionnaire survey responded there was no evacuation drills.   Even if there were evacuation drills, the frequency was about once a year in many cases.   In terms of a hazard map, about 80% of the respondents answered there was no hazard map in their communities. There was a tendency that the areas where NGOs worked had hazard maps and evacuation drills. It is important to expand education on disaster risk management and conduct exercises for other areas.   Expansion of disaster risk management education through activities focusing on students, evacuation drill along with multiple possible scenarios and development of hazard maps is to be contributed to strengthen disaster resilient communities.

Most respondents who did not evacuate while receiving a warning mentioned they were afraid to lose their possessions such as livestock.   There were also cases that the heads of households stayed in their houses while they made their family members evacuate.   It is important for community people to acquire appropriate knowledge on disaster risk management such as the danger of when they evacuate at the last minute.   As a structural measure, an Upazila DMC mentioned the possibility that if there were Killas next to cyclone shelters, it would contribute to increase the percentage of evacuation.

This is a good time for enhancement of disaster risk reduction capacity by conducting education and exercises.

(3) Education, Exercises and Awareness Raising of Fishermen

There is a problem regarding fishermen about awareness as well as problem on information dissemination to fishermen.   Many of them have radios and they tend to listen to them more than others.   However, they pay only little attention to disaster information.

When a warning is issued, the navy lets fishermen know about it, and they come back to ports. However, there are some cases that they go offshore soon after the navy leaves.   Moreover, there is a tendency that fish comes to the shore when a cyclone is approaching, and fishermen

go to catch them.

The Establishment of an information communication system and awareness raising through education and exercise is to be one of the major challenges.

Information says no damage was reported to fishermen at the time of Cyclone Mahasen (May 2013). This was due to the warning being delivered to them earlier in case of Cyclone Mahasen (May 2013).

(4) Rehabilitation and Reconstruction after Disasters

Rehabilitation and reconstruction operations after disasters are not progressed due to lack of budget.

As an example, polders were completely destroyed by Cyclone Aila (May 2009) in some areas. Some of the areas are inundated even now because of no operations have been taken. In those areas, people had to reconstruct their houses on or near destroyed polders, and the communities became like slums for two (2) years. Regarding roads, rehabilitation and reinforcement works have not been progressed, and the road condition becomes very muddy under the rainy weather. The condition affects evacuation as well. If adequate structural measures are taken, rehabilitation and reconstruction processes can be progressed smoothly.

Focusing on resume of schools, some schools were closed for two (2) years after Cyclone Aila (May 2009). This affects level of education, and will work negatively for students' future.

In terms of resume of work, the result of the survey to community people showed it took five (5) months to resume their works (mean value of Bagerhat District).

The current income level is lower than before cyclones for nearly 40% of the respondents. Some respondents answered it became a half the income before cyclones. Cyclones may not be the only reason of the reduction, but definitely cyclones affect the income level during reconstruction process.

Implementation of structural measures and development of a system which focuses on rehabilitation and reconstruction process are essential to reduce a burden during rehabilitation and reconstruction processes.

(5) Problems at Community Level and Suggestions to CBDRM

Community people are the receivers of early warnings. The problem that exists in the receivers' side is they wait until the last minute to evacuate. The major reasons of the tendency are to protect livestock and property, the long distance to cyclone shelters, inaccurate warnings and because Allah says so. For people who live in the vulnerable areas, the distance to safe

evacuation sites are far in most cases.   The road condition is very poor as well.

From the perspective of reconstruction of their lives, livestock and property are very important components to maintain their incomes.   Once they lose them, it is very difficult to reconstruct their lives, and therefore, it is a tough decision when they need to evacuate without livestock and property.   As a result, when they make the decision to evacuate, the level of inundation is too high, and it leads to a high percentage of casualties.

The important items to improve the current situation are development of an environment in which people can evacuate without any worries and an opportunity to receive disaster risk management education to acquire appropriate knowledge.   Especially, conduction of disaster risk management education at schools is effective since new students can learn about the topic every year and the knowledge will expand to the communities.   It will be effective to visually show the risk that occurs if they wait until the last minute to evacuate.   Development of a disaster risk management plan at community level is also important to clarify the role of each actor in both normal occasions and emergency times.   It is recommended to conduct evacuation drills based on the plan along with multiple possible scenarios.

As mentioned in "5. Cyclone Shelter", problems with cyclone shelters affect the current situation negatively.   Development of a daily maintenance system and a management manual during disasters is essential.   Exercises on management of cyclone shelters are very important as well.

Coming back from evacuation sites is not the end of disasters.   People have to reconstruct their lives from there, and this is the biggest challenge for them.   Implementation of structural measures and development of a system which focuses on rehabilitation and reconstruction processes are essential to create disaster resilient communities.

6.2.   Warning Level in SOD

(1) Level of Warning

A 10-level warning has been adopted in the SOD.   On the contrary, CPP is using a different type of 10-level warning, which is for marine use.   A new warning method which using 6 levels is also mentioned in the SOD, but the implementation is practically impossible at this moment for the following reasons:

-CPP has used the 10-level warning for a long time.

-Community people will misread the warning level and will not evacuate although they have to.

At the same time, a 4-level warning system is also used for rivers.   However, information

indicates that the 10-level and 4-level warnings are given at the same time on TV and radio and there is confusion among community people.   In CPP, they are aware of the 4-level warning, but they are not using it.   A more detailed, reliable and consistent warning is essential.

(2) Other Issues

The SOD clearly defines roles and responsibilities of disaster risk management related organizations.   However, there are some items which are not implemented as mentioned in the SOD.   These issues are described as follows:

a)   Recognition of SOD

There are cases that the SOD is not recognized below Union level.   Seminars using the SOD are needed for DMC and CPP.

b)   DMC

i)   Normal Period

Frequency of meetings:

According to the SOD, a meeting should be held once in two (2) months at District level and once a month below Upazila level.   Practically, some areas have difficulties to hold the meeting is as defined in the SOD.   Correspondingly, the frequency is reset to once in every two (2) months for some areas.   It is recommended to review the frequency which is to obtain a time schedule suitable.

Evacuation Drill:

Evacuation drill is not fully implemented as mentioned in the SOD.   A practical implementation system and the ensuring of a budget should be developed.

Emergency correspondence plan and other plans:

An emergency correspondence plan, evacuation plan, a disaster risk management plan are to be formulated.   However, they have not been fully formulated yet.   Development of a practical system or assistance may be helpful for formulation of these plans.

ii)   Warning Period

Evacuation drill:

The SOD mentions the necessity of conduction of evacuation drill during warning periods. At this moment, evacuation drills are not fully conducted even in normal period.   Therefore, conduction of evacuation drill during warning period is practically very difficult, and it is recommended to review the system.

Dissemination of warning:

The SOD defines some responsibilities as follows:

-to conduct early warning dissemination,

-to help the evacuation of residences in vulnerable areas to safe evacuation places along with an evacuation plan,

-to check the situation of preparation for rescue

-to organize a rescue team

In a reality, only some parts of DMC are able to fulfill these responsibilities.　Training for DMC is highly recommended to fully perform the roles.

c)　CPP
Training during normal time:

Training is to be conducted twice a year (April and September).　However, the training has not implemented due to lack of budget.　Training for new CPP volunteers is to be conducted once a year before April.　The training has not been fully implemented as well.

d)　Information about Water Level
The SOD does not define the role and responsibility of water level measurement.　Roles and responsibilities regarding acquisition of water level information and dissemination of the acquired information need to be clarified among BMD, BWDB as well as BIWTA.

(3) Suggestion to Challenges

It is reasonable to assume that the challenges seen in the SOD are reviewed and revised in related organizations such as MoDMR and DDM.　However, there is a possibility that some of them have not planned based on practical situations.　Therefore, capacity development of disaster related organizations including DDM are necessary to make the SOD more practical.

6.3.　Erosion

(1) Current Situation and Challenges

When the team used a small boat to visit Char Abdullah Union of Ramgati Upazila in Laxmipur, they found severe erosion on both sides of the river.　It was corroded about 1.5km width and for 3km, and this had happened in 5 years.　The other side was corroded 1km only in three (3) months.

According to BWDB of Lakshmipur, a plan has been submitted to the government to repair a polder for 5.5km at 3 major points.　The expected budget is 2 billion BDT for 2 years.

However, in a reality, the polder is damaged on average 2 to 3 km per year.　Therefore, it will be very difficult for them to repair everything even if they receive the budget from the government.　Damage to polders from erosion is a critical problem in disaster risk

management.

Many communities have a view that the level of damage decreased after repairing the polders. However, there is a huge number of polders and equipment which are left unrepaired due to lack of maintenance.   This shows the importance of structural measures.

(2) Correspondence

When a structural measure is taken, attention should be paid to the fact that the erosion occurs as a part of passage change at the mouth of the Meghna River.   Continuation of passage change means continuation of erosion at different parts.

Countermeasure construction such as revetment work is generally effective.   However, erosion occurs for 2km even if new polder is constructed for 2 km.   Therefore, the countermeasure is not effective at this moment.

Analysis of erosion pattern and comparison with non-erosion area are recommended to be conducted first, and decide appropriate areas for the countermeasure.

6.4.   Ensuring Transportation Means

(1) Issues

There is severe scarcity of transportation means for rescue activities at District, Upazila, Union and Unit levels.   Therefore there is high demand for ensuring transportation means such as motorcycles and motorboats.   They will also be useful for delivery of relief supplies and as a communication means for isolated areas.

Especially, lack of rescue boats affects in the current condition badly because the number of people who can be saved is limited without rescue boats.   If there are rescue boats, they could be used for rescue activities of fishermen as well.   For this reason, demand for rescue boats is especially high.

Regarding motorcycles, they could be quite useful for warning delivery.

Development of a road network should be discussed as another issue.   When the team visited Padma Pukur Union of Shyamnagar Upazila in Satkhira, the road condition became too muddy to walk due to the rain.   Development of road network is an urgent matter to be handled.

(2) Correspondence

Motorbikes, motorboats and other means of transportation should be allocated at each area. They are effective for early warning dissemination as well as rescue.   Therefore, it is desired to

enhance the capacity for information dissemination after disasters.

Development of road network is also very important. It is better to develop not only access roads to cyclone shelters but also major roads

7. Issues of Early Warning and Disaster Information System in Coastal Area and Possible Assistance Scenario by JICA

The previous chapter mentions the issues and the possible countermeasures of early warning and disaster information systems in coastal areas.   In this chapter, a possible middle and long term assistance scenario by JICA in the future, particularly the assistance scenarios which have validity, the highest priority and urgency are presented.

7.1. Issues and Policy

Summary of the issues and possible countermeasures mentioned in the chapters are evaluated in Table 7.1.   The evaluation was made in terms of priority, urgency, implementation period of countermeasures (short term: 2-3 years, middle term: 5 years, long term: more than 10 years) and effective and efficient assistance by Japan.

Table 7.1   Summary of Issues

Issues	Priority/ Urgency	Implementation Period	Effectiveness/ Efficiency of Japanese Assessment	Evaluation	Explanation
■ Early Warning/ Disaster Information System					
・Early Warning/ Disaster Information System	◎	short to middle term	◎	◎	It is recommended to develop a system urgently. Japanese technology can contribute for development of the system. JICA is implementing a project in loan assistance for development of information infrastructure.
・Capacity Enhancement for Early Warning and Disaster Information System	◎	short to middle term	◎	◎	Capacity enhancement using the system which is to be installed is essential.
■Cyclone Shelter					
・Construction of new Cyclone Shelters	◎	short, middle and long term	○	○	This is the highest priority to ensure safe places to evacuate. However, other donors including WB have projects for construction of new cyclone shelters. An intensive coordination is needed among donors.
・Rehabilitation of Cyclone Shelters	◎	short, middle and long term	○	○	Same as above.

Issues	Priority/ Urgency	Implementation Period	Effectiveness/ Efficiency of Japanese Assessment	Evaluation	Explanation
・Review of current Equipment and Rehabilitation	○	short, middle and long term	○	○	Equipment of cyclone shelters does not have a direct relation to life and death. However, it is important in terms of whether people would agree to evacuate.
・ Complement of Fixtures	○	short, middle and long term	○	○	Same as above. Relief supplies such as water and food are provided by NGOs immediately after disasters.
・Update of Cyclone Shelter List	◎	short to middle term	○	◎	This is the highest priority to specify areas where cyclone shelters are necessary. Some parts are updated in CDMP
・Formulation of Development Plan	◎	short to middle term	○	◎	Formulation of development plan based on the cyclone shelter list is the highest priority
・Formulation of Evacuation Plan	◎	short to middle term	○	◎	An evacuation plan needs to be formulated for cyclone shelters with high priority.
・Development of Maintenance System	◎	short to middle term	○	◎	Equipment of cyclone shelters does not have a direct relation to life and death. However, it is important in terms of whether people would agree to evacuation.
・Development of Operation Manual	◎	short to middle term	○	◎	Same as above.
■CBDRM					
・Education on Disaster Risk Management	◎	short to middle term	◎	◎	The highest priority is that community people acquire the knowledge of disaster risk management.
・Evacuation drill	◎	short to middle term	◎	◎	This is important to protect people's lives by evacuating at appropriate time and to appropriate places
・Development of Hazard Map	◎	short to middle term	◎	◎	Hazard map is basic information of evacuation. However, this is under development. This is another priority and needs to be developed. Currently, USAID and Save the Children have projects for development of a hazard map.
■ Improvement of the SOD					
・Review of activities of DMC/ CPP during Normal and Warning Times	◎	short to middle term	○	○	It is important to review the SOD to make it more practical. The SOD was developed by UNDP.

Issues	Priority/ Urgency	Implementation Period	Effectiveness/ Efficiency of Japanese Assessment	Evaluation	Explanation
・Review of Policy for Obsevatoin of Water Level Information	◎	short to middle term	◎	◎	Development of a water level observation system is important for early warning.
・Capacity Enhancement of Disaster Risk Management Related Organizations	◎	short to middle term	◎	◎	The related organizations do not have enough opportunity for education and training. Capacity enhancement to implement the SOD is important.
■Erosion					
・Analysis of Stable and Unstable areas of Erosion	○	short to middle term	○	○	This is basic information to implement structural measurements. It is desired to be implemented using a long term perspective.
・Structural Measurements	○	middle and long term	◎	○	The situation for structural measurements is very critical. Medium and long term perspectives are needed for implementation. WB currently is developing a project.
■ Transportation Means					
・Transportation Means(Motorbike, Motorboat)	◎	short and middle term	○	◎	There is a high need for transportation means. They can be used for early warning information dissemination as well as for rescue activities.
・Development of Evacuation Routes/ Road networks	◎	short, middle and long term	◎	◎	Development of road networks is the highest priority since development affects.

Source: JICA Survey Team

According to the table above, the highest priority is given to

-Early warning/ disaster information system,

-Capacity enhancement for early warning/ disaster information system

-Cyclone shelters

-CBDRM

-Revision of the SOD

-Transportation means

Erosion is also important, but middle and long term assistance is needed. Regarding construction of cyclone shelters, other donors work on this area and therefore the highest priority is not given to the area. However, the evaluation of Japanese technology is high, and demand for Japanese assistance is high. The highest priority is given to cyclone shelters, but

formulation of a development plan may be needed among the donors before implementation of assistance.

Ideally the revision of the SOD is done by MoDMR and DDM, but some parts of the SOD do not match the current situation of implementation organizations. Coordination with organizations related to disaster risk management such as BMD, BWDB and Public Works Department is essential. It is also important to collect and analyze data from the related organizations and develop practical policies and disaster risk management plans.

7.2. Assistance scenario

Based on the evaluation made in the above section, high priority is given to three (3) categories, and they are "(1) Improvement of Conditions surrounding Cyclone Shelters including Evacuation Routes", "(2) Early Warning and Disaster Information System" and "(3) Capacity Enhancement for Early Warning and Disaster Information System.

(2) and (3) should be handled urgently. Regarding (1), many donors implement projects in the area, so the priority in JICA is not necessarily the highest. It is recommended to establish model areas after a comprehensive development plan is formulated among donors. Some NGOs implement projects to build cyclone resilient housings. This is another possible assistance to implement with considering the number of target housings and geographical conditions.

(1) Improvement of Conditions Surrounding Cyclone Shelters including Evacuation Routes

Based on the result of the survey, the capacity of cyclone shelters is only 10-20 % of the population ratio (this data only focuses on cyclone shelters, and concrete buildings which can be used as evacuation sites are not considered. However, there are few concrete buildings in case of rural areas, and therefore, it is reasonable to consider the rate to be about 20%).

That means around 80% of residents have no place to go in a disaster even after implementation of "(2) Early Warning and Disaster Information System" and ("3) Capacity Enhancement for Early Warning and Disaster Information System". Therefore, improvement of cyclone shelters is one of the most important issues to be considered.

Based on the interview survey, it takes around 30 minutes to cyclone shelters on average, the maximum is 3 hours.

When access roads become muddy by heavy rains, it could take more than 2-3 times than usual. The evacuation rate will decrease because it is difficult to evacuate under such road conditions.

Establishing model areas after selection of high-priority areas, conditions surrounding high priority cyclone shelters should be improved including evacuation routes.

When this assistance is adopted, the project should be a model project in the area by not only focusing on necessary facilities of cyclone shelters, but also focusing on operation and maintenance of cyclone shelters as well as development of the environment around cyclone shelters.

In some cases, cyclone resilient housings are more suitable than cyclone shelters. When priority areas are selected, examination of cyclone resilient housings should be conducted.

Activities aimed at the cyclone shelters and their surroundings are a good project for the future.

- Improvement of Cyclone Shelters
  - Identify high priority areas of Cyclone Shelters
  - Construction of Cyclone Shelters
  - Repair of Cyclone Shelters
  - Improvement of facilities in Cyclone Shelters

- Improvement of road network around cyclone shelters
  - Improvement of evacuation routes to high priority Cyclone Shelters

(2) Early Warning System and Disaster Information System

"(2) Early Warning and Disaster Information System is designed to enhance a system which disseminates disaster information before disasters hit based on analysis of related organizations such as BMD. It is desired that activities of each organization effectively work together until the reconstruction process. According to a JICA project called "Data Collection Survey on Strengthening of Disaster Tolerance in Cyclone Affected Area Final Report", only 20% of people were evacuated before cyclone Aila (May 2009) hit. The reason of the low evacuation rate is the people cannot make the right decision as to when an evacuation is needed. The contents of warnings need to be improved so that people can understand them properly.

According to the SOD, BMD should issue warnings at least 10hours before in the "Great Danger" stage. This was not such a serious issue during Cyclone Mahasen (May 2013) because Cyclone Mahasen (May 2013) moved slowly. However, if the situation is suddenly changed like with Cyclone Aila (May 2009), it would be almost impossible to give 10 hours lead time. It must be considered how many hours are adequate for lead time, the 5-6 hours lead time which is almost half of the 10 hours stated in the SOD could be a target. Therefore, an early warning system which can transmit warnings to community people within 5-6 hours lead time should be the target. Especially, it takes a longer time to transmit warnings to isolated areas including Char Areas, the system should be able to transmit warnings within a

certain lead time.

Some of the principal equipment is a "Remote control speaker-siren system" and in order to supplement the speaker-siren system, "Mobile speaker (speaker with Vehicle/ Motorbike/ Bicycle) is recommended. Also "Satellite Mobile Phone" is mainly for the disaster Information System.

For the Disaster Information System for request of emergency relief, only mobile phones can be used below Union level. Mobile phones are vulnerable during and after disasters, therefore a system with satellite mobile phones should be installed as a complementary system. At the same time, an information communication system with satellite mobile phones among government organizations related to disaster risk management should be established.

It is effective to install the equipment below in the high priority areas.

➢ Establishment of Early Warning System and Disaster Information System

- Counterpart and target organizations
  - DDM ⇔ District ⇔Upazila ⇔ Union
  - Organizations related to disaster risk management
- Equipment
  - Remote control speaker-siren system
  - Mobile speaker (speaker + Vehicle/ Motorbike)
  - Satellite Mobile Phones

(3) Capacity Development for Early Warning and Disaster Information System

"(3) Capacity Enhancement for Early Warning and Disaster Information System" is designed for community people to recognize warnings appropriately, and evacuate before disasters hit as well as capacity enhancement for early warning and disaster information systems among DMC, CPP and other related organizations.

Related to "(2) Early Warning System and Disaster Information System", training and evacuation drills should be conducted with newly installed equipment. These activities aim at completion of the evacuation within a certain time. Also the activities aim at development for capacity of disaster risk management of community people and improvement of the evacuation rate of community people who need to be evacuated.

At the same time this project aims to assist people to acquire basic information of disaster risk reduction. This will contribute to increase the evacuation ratio. The important items to improve the current situation are development of an environment in which people can evacuate

without any worries and an opportunity to receive disaster risk management education to acquire appropriate knowledge.   Especially, conduction of disaster risk management education at schools is effective since new students can learn about the topic every year and the knowledge will expand to the communities.   It will be effective to visually show the risk that occurs if they wait until the last minute to evacuate.   Development of a disaster risk management plan at community level is also important to clarify the role of each actor in both normal occasion and emergency time.   It is recommended to conduct evacuation drills based on the plan along with multiple possible scenarios.

Focusing on a hazard map, based on the results of the interview survey, around 80% of interviewees said that there is no hazard map.   Therefore development of hazard maps is one of the most important issues to be considered.   Also the number of people who need to evacuate should be identified as well as distribution of cyclone shelters and buildings which can be used as shelters.   Based on the distribution map above, an evacuation plan should be prepared.

Based on the interview survey, interviewees said that operation and maintenance are one of the most important issues for cyclone shelters.   Therefore, in order to improve the evacuation rate, development of capacity for management of cyclone shelters should be considered.

Lastly, the SOD has some parts which are not practical to implement.   Therefore, capacity enhancement of disaster risk management related organizations are to be made by reviewing the SOD.

Items to be included in the agenda are shown below.

➢ Capacity Development for Early Warning and Disaster Information System

● Awareness raising

- Implementation of disaster risk management education at schools
- Assistance for development of hazard map
- Assistance for development of community disaster risk management plan
- Assistance for evacuation plan
- Implementation of evacuation drills
- Capacity enhancement for appropriate operation and maintenance of cyclone shelters using the system which is to be installed

● Development of disaster risk management capacity of DMC/CPP

- Training and evacuation drill led by DMC/CPP
- Preparation of development plan of cyclone shelters

● Review of the SOD