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Natural disasters in Bangladesh and Japan - comparing its scale and damages

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Abstract: Bangladesh is located on the Bengal delta made by sediments from Himalayas and, on the other hand, Japan is the isolated islands surrounded by sea, which makes the difference between these two countries in scale, frequencies and damages of natural disasters. During a last hundred years, the storm and the earthquake occurred frequently and caused a lot of damages to human life and national economy in Japan. In contrast, the storm and the flood have been worst natural disasters in Bangladesh. Frequency of the storm in both country are almost same but the number of deaths in Bangladesh are 18 times more than that of Japan. Frequency and the deaths of flood in Bangladesh are larger than those of Japan although total amount of damage is equivalent. The economic damage of Bangladesh is 2.4 times larger than that of Japan in the percentage of GDP although total real damage amount of Japan is 20 times larger than that of Bangladesh. The fact shows Bangladesh has economically received bad influences not at all inferior to Japan.
Key words: Bangladesh, Japan, natural hazards, disaster management.

Introduction

Bangladesh is located on one of the biggest deltas in the world which has been made by three large rivers. The Ganges and Brahmaputra rivers transport enormous run-off and soil from the Himalayan drainage system (or Himalayan river basin system) and another big river Meghna gathering top of the world's amount of rainfall from Meghalaya joins in the country. The plain topography of delta and massive amount of water creates a characteristic hydrological zone which is often flooded with river channel erosion. Moreover, the country is facing the Bay of Bengal which is opening way for cyclones. Thus the combination of such facts the country is located on the end of Himalayan watershed and faces the Bay of Bengal makes Bangladesh a country of “natural disasters” (Fig. 1a). On the other hand, Japan is located in the circum-Pacific mobile zone where seismic and volcanic activities occur frequently. Japan itself stands on four tectonic plates some of which are subducting and pushingeach other as shown in Fig. 1b. Such moving tectonic plates make the country unstable geologically and it is said there are many active fault lines more than 2,000 in Japan. Due to such geographical and geological condition, number of earthquakes with magnitude of six or greater recorded 190 in a decade (1996-2005) which is 20% of total in the world and number of active volcanos is 108 equal 7% of the total (GoJ. 2002).

Moreover, because the national land extending north, south, east and west widely is surrounded on all four sides by sea, it is also subject to meteorological disasters such as typhoons, torrential rains and heavy snow. In this paper the author compares damages of natural calamities in both countries about its scale and frequency.

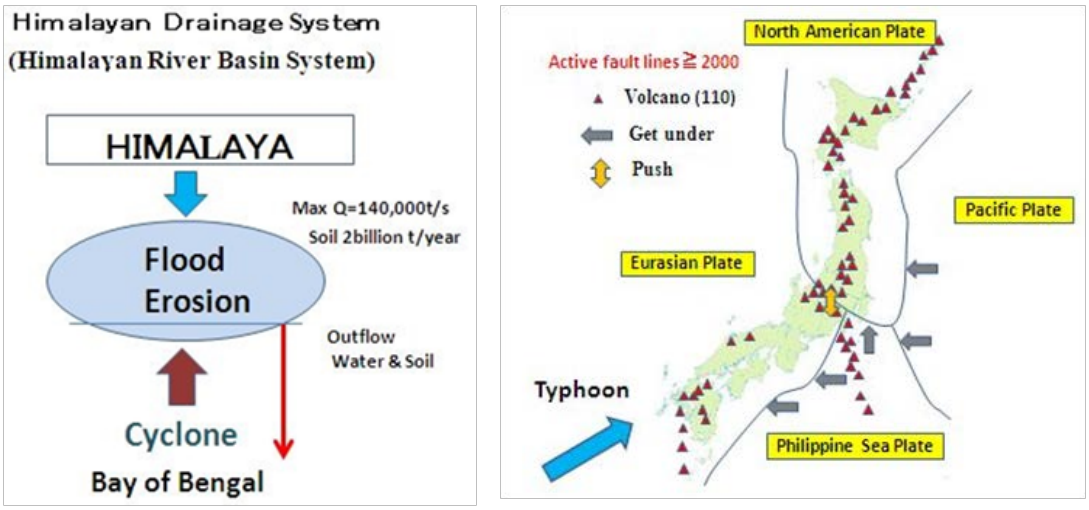

Fig. 1. Location and natural disasters in Bangladesh (A) and Japan (B)

Materials and Methods

Since 1988 the WHO Collaborating Center for Research on the Epidemiology of Disasters (CRED) in Belgium has been maintaining an Emergency Events Database EM-DAT. EM-DAT contains essential core data on the occurrence and effects of over 18,000 mass disasters in the world from 1900 to present. The database is compiled from various sources, including UN agencies, non-governmental organizations, insurance companies, research institutes and press agencies.

In order for a disaster to be entered into the database at least one of the following criteria has to be fulfilled: (i) 10

or more people reported killed, (ii) 100 people reported affected, (iii) a call for international assistance, (iv) declaration of state of emergency.
The author discusses about the natural disasters in Japan and Bangladesh using the summarized tables of five kinds of natural disasters (earthquake, flood, landslide, storm and drought) which seemed to be important for both countries. Moreover, tables of top ten natural disasters sorted by numbers of death, sufferer and economic damage are also referenced secondarily. All data for making tables are recorded between 1900 and 2013. The used EM-DAT database version is 12.07 created on July 29, 2013(OFDA/CRED 2013).

Results and Discussion

Frequency, number of death and sufferer, worst 10 natural disasters

Table 1 shows frequencies of main five natural disasters in Japan and Bangladesh between 1900 and 2013. Table 2 indicates the number of deaths and sufferers by five disasters respectively and Table 2 lists worst 10 disasters in regard to number of death during the same period.

Table 1. Natural Disasters in the two countries (Frequency)

(1900-2013)[1,2]

Disaster	Frequency	
	Japan	Bangladesh
Earthquake[3]	57	7
Flood[4]	47	85
Landslide	21	3
Storm[5]	149	165
Drought	1	7
Total	275	267

1.EM-DAT:The OFDA/CRED International Disaster Database
2.10 more killed/100 more affected/emergent declare/call international assistant
3.inc. TSUNAMI 4.inc. storm surge, coastal flood 5.inc. cyclone, typhoon, local one

Earthquake: As mentioned in the previous chapter, the frequency of earthquake in Japan is eight times as high as in Bangladesh (Table 1) and total number of deaths by earthquakes during a century is by far highest in all natural disasters in Japan (Table 2). Moreover, top four causes of highest number of deaths are earthquakes and half of the worst top 10 disasters are also earthquakes in Japan (Table 3). On the other hand, very little victim of earthquakes can be seen and there is not any earthquake ranked in worst top ten disasters in Bangladesh (Table 2 and 3).
Regarding Japan, it is remarkable that both of massive earthquakes, namely the 2011 off the Pacific coast of *Tohoku* Earthquake which had largest magnitude of 9.0 in recorded history and *Han-Shin Awaji* Earthquake disaster of 1995 which was a typical inland earthquake, occurred within these two decades. Moreover, recent earthquakes have brought in new social problems such as sense of emergency of the strong urban earthquake and sense of weakness against nuclear electric power generation. Following these several events the Japanese government has pointed out with a great sense of urgency that Japan can be struck by large-scale earthquakes in the next few decades. Especially, large-scale earthquakes around *Nankai* Trough, trench type earthquakes in the vicinity of the Japan and *Chishima* Trenches and Tokyo inland earthquake are attracting attentions (JoG. 2002).

Table 2. Natural Disasters in two countries (Deaths and sufferers)

(1900-2013)[1,2]

	Deaths(1,000)		Sufferers(1,000)	
	Japan	Bangladesh	Japan	Bangladesh
Earthquake[3]	194	0	1,389	19
Flood[4]	13	52	7,573	317,631
Landslide	1	0	26	55
Storm[5]	35	635	7,863	77,385
Drought	-	1,900	-	25,002
Total	243	2,587	16,851	420,092

1.EM-DAT:The OFDA/CRED International Disaster Database
2.10 more killed/100 more affected/emergent declare/call international assistant
3.inc. TSUNAMI 4.inc. storm surge, coastal flood 5.inc. cyclone, typhoon, local one

With regard to every large-scale earthquake in Japan, the government has conducted examinations to clarify the characteristics of the earthquakes, estimate the damage and identify necessary countermeasures. The following set of plans and strategies for each large-scale earthquake are now being developed: “the Policy Framework”, a master plan that includes a range of activities from preventive measures to post-disaster response and recovery; the “Earthquake Disaster Reduction Strategy”, to determine an overarching goal of damage mitigation and strategic targets based on the damage estimation; and the “Guidelines for Emergency Response Activities”, which describes the action to be taken by related organizations (ibid).
Meanwhile, because of location of Bangladesh in a tectonically active area a strong earthquake could occur in the plate boundaries. Bangladesh is closed to the meeting point of the Indian, Eurasian and Burma (Myanmar) plates. Although large-scale earthquakes are reported only seven times during a century (Table 1), the meteorological department of Bangladesh detected at least 90 earthquakes taking place in the country between May 2007 and July 2008, nine of them above five on magnitude and epicenters of 95 percent being within a 600 km radius of Dhaka city (Ferdous and Pahman, 2010).
The earthquake record suggests that since 1900 more than 100 moderate to large earthquakes occurred in Bangladesh, out of which more than 65 events occurred after 1960. This brings to light an increased frequency of earthquakes in the last 50 years. This increase in earthquake activity is an indication of fresh tectonic activity or propagation of fractures from the adjacent seismic zones (Banglapedia Earthquake, 2013).
Moreover, it is these increased tremors that indicate the possibility of much more powerful earthquakes hitting the country. It is obvious that if a major earthquake hits Bangladesh it will create havoc and damages of life, properties that is unimaginable because of not only no awareness among the people but also poor preparedness by the government including lack of support facilities.

Now is the time to prepare to face the major earthquake disasters (Ferdous and Pahman, 2010).

Flood: Table 1 and Table 2 show flood frequency, number of deaths and sufferers of Bangladesh is 1.8, 4 and 45 times larger than that of Japan. Other EM-DAT indicates the frequency of unspecified and storm surge /coastal flood is same in the both countries and the number of general and flash type floods in Bangladesh is larger.

Main reasons of flood in Japan are meteorological conditions such as precipitation and active weather-front systems and geographical conditions such as precipitous terrains and steep rivers. One half of population is concentrated in possible inundation areas, which account for about 10% of the national area. Although there has been a large reduction in the area inundated by floods owing to soil conservation and flood control projects over many years, the amount of general assets damaged in flooded area has increased to 4 times of 20 years before. Additionally, as a long-term trend, there is an increasing tendency of downpours throughout the country. The number of last decade of heavy rains with precipitation of 100 mm or more per hour increased two fold of two decades ago (GoJ, 2002). The increasing trend of downpours in recent years requires the intensification of counter measures for quick and reliable evacuation and relief activities. The central disaster management council has been working on against flood disasters supposed to cause immense damage to the big town, especially capital region. In Japan, an urban flood that directly hits Tokyo area is a matter of special importance like such kind of earthquake.

On the other hand, the floods of Bangladesh indicate the area extent of flooding is gradually decreasing in the longer term and, at the same time, inter annual variability of the flood-affected areas has significantly increased since 1975: years with a low flood extent have become more frequent (Hoffer and Messerli, 2006).The failure of Flood Action Plan (FAP) to protect the country from floods has cleared the institutional assessment should examine practical means to overcome governance constraints and to increase local responsibility for managing flood protection and irrigation projects (Brammer, 2010). This means the government to be reformed and cooperate with people to protect the country.

Landslide: In Japan, there have been 21 major landslide disasters during the last one hundred years (Table 1) and if limited to post-war period up to 1995 it occurred 9 times and 149 persons were killed in total. Including large and small size ones 1,353 landslides occurred during 1990-1999 mainly caused by melted snow, seasonal rain (in the rainy season), typhoon, heavy rain etc. (GoJ, 2013).

Housing developments in mountainous and hilly areas have been extremely vulnerable to landslide disasters in more recent years. Additionally, as a long-term trend, there is an increasing tendency of downpours throughout the country. It is also a new residential area located on the edge of mountain that the landslide which caused by downpours and killed 74 persons in Hiroshima at the end of August 2014. On the back of such situation the governments of national and local authorities designate areas of active landslide movement or high risk areas of such movement as landslide threatened areas pursuant to the Landslide Prevention Law and conduct landslide surveys and prevention (control) works in these areas. Number of such designated area was 3,329 and 114,023 ha in 1999 (ibid.).

In Bangladesh, landslide disasters concentrate in south-eastern part of Bangladesh which is hilly and mountainous area. Although Table 1 shows only three landslide disasters in a century, Bangladesh Water Development Board (BWDB) reported Chittagong suffered about 12 times landslides during the last five decades. In recent years this disasters are more accelerated by human activities such as indiscriminate hill cutting for housing and brick field and deforestation etc. Consequently, by the devastation of this disaster the death toll is approximately 200 during these 12 years from 1999 to 2012 (Sarkar and Rashid, 2013).

Landslide is not listed in Table 2 and 3 as worst disaster in both countries. This is because the event is local and its damage is limited in one occurrence. Landslide events take place in remote and isolated area which is difficult to reach. The external helps may take several days to rescue the affected communities, especially in Bangladesh which has not enough communication roads. During their waiting period people of affected communities have to cope with their resources and arrangement. Therefore not only structural mitigation measures, legal enforcement of prohibiting uncontrolled hill cutting, enhancement of public awareness and so on but also community based risk reduction strategies such as equipment and distribution system of common resources, community-based early warning system, training for effective response etc.are also required (ibid.).

Storm: Frequencies of storms consisted chiefly of cyclone in Bangladesh and typhoon in Japan are more of the same (Table 1). Tropical stormsmake landfall easily in both of Japan surrounded by sea and Bangladesh facing sea. Especially, the low topography and funnel shaped coast line of Bangladesh makes the coastal associated with cyclones. 8.4% of the country can be area subject to high surge identified as the risk zone (RZ) upto which storm surge might travel inland. Within the area of RZ, 6.4% is the high risk zone (HRZ) where surge height may exceed 1m and people are likely to be killed from drowning (BUET-BIDS, 1993).

Although there is not much difference in frequencies, the number of fatalities and sufferers of Bangladesh are much larger than that of Japan. In the recent years, it is said the 1970 *Bhola* cyclone alone caused 500,000 (number is likely to be higher) death and the 1991 Bangladesh cyclone killed 150,000 people (Wikipedia Cyclone 2013).

In the 21st century, *Sidr* of 2007 and *Aila* of 2009 are two big cyclones struck Bangladesh. Particularly, *Sidr* was climatologically equal to cyclones of 1970 and 1991, nevertheless the death count was about 5,000. Such less casualties can be attributed to the Multipurpose Cyclone Shelter Programme (MCSP) followed by the construction of shelters and organized activities of Cyclone Preparedness Program (CPP) (Mallick and Rahman, 2013).

After the disastrous cyclone and storm surge which hit the coast on April 1991, Bangladesh government initiated the project searching the need for cyclone shelters with UNDP and the World Bank fund. Under the name of Multipurpose Cyclone Shelter Program (MCSP) it was reported that 2,500 cyclone shelters in HRZ would be needed in the year 2002 and 60% of the shelter were proposed to be located in existing primary school. In total, there are some 2,200 cyclone shelters at present in the coastal area while a total 4,000 shelters are considered as required to ensure the safety of the coastal population. Although the number of shelter is hardly adequate at the moment, there is almost no doubt that increasing shelters have been useful for the people to escape from disasters in these two decades.

The Cyclone Preparedness Program (CPP) is implemented by the government and Bangladesh Red Crescent Society (BDRCS) at administrative level. At the field level, the programme is implemented by the teams of volunteers in the minimum unit. Each unit serves 1 or 2 village with an approximately population of 2 to 3 thousand. 10 male and 2 female volunteers are recruited from the respective unit. In each unit, the 10 male volunteers are divided into 5 groups to discharge such responsibilities as to disseminate cyclone warning signals, to assist people in taking shelter, to rescue distressed people and to assist in relief and rehabilitation operations using provided equipment like siren, transistor radio etc. Two female volunteers of the unit provide first aid to the distressed women after the cyclone besides their task of raising awareness among the women folk in normal time. Historically speaking, the ideas of CPP started in 1965 and it has been developed to be marked by a favorable outcome (Harun-AL-Rashid, 1997).

In Japan "disaster countermeasure basic act" was enacted to develop comprehensive disaster prevention and administration in the aftermath of rare strong typhoon *Ise-wan* in 1959 (Table 3) (GoJ, 2002). Since then the government have aimed to establish the disaster prevention system which withstands super-typhoon like *Ise-wan*. Consequently, the damage of typhoon has decreased more definitely after the middle of twentieth century, which resulted from development of academic research works, advancement of weather forecast, institutional building based on experiences in administration, transmission of disaster records and voluntary organization among ordinary citizens. Nevertheless some areas of Japan get great damages and need to strengthen more safety measures. In a situation like that the government starts to formulate the action plan of "time line" which indicates countermeasures hour by hour in advance to reduce the damage in urban areas (NHK 2014). It is reported that the damage could be reduced because the subways had been stopped running one day before the occurrence of surge following "time line" in the United States when Hurricane Sandy attacked in 2012. Based on this Japanese government would request public transport to participate the discussion about time line action plan. The government is planning to compile countermeasures used for the action plan by this rainy season and it seems to take a few years at least to formulate the final action plan. Anyway, the idea of "time line action plan" can be worthwhile one for not only Japan but also Bangladesh.

Regarding the tornado, in Japan, 246 events (including small scale ones) have been observed during 18 years from 1991 to 2008 (JMA, 2013a). Most of them distributed along the coasts nationwide killing 12 and injuring about 600 persons (J.Wikipedia Tornadoes 2013). Although it was difficult to forecast incidents of tornadoes in past times, prediction accuracy has risen up to 20-44 % nowadays in Japan (JMA, 2013b).

According to the list of "86 tornados in Bengal for 1838-2001", 67 tornadoes struck Bangladesh of which 19 were reported to have caused deaths of 100 or more each while at least six incidents caused death of more than 500 people each (Finch 2013).

Thus the damage by tornadoes in Bangladesh is more serious than that of Japan. In the aftermath of two catastrophic disasters in 1989 and 1996 resulted in 1,300 and more than 700 fatalities respectively, the local neglected disaster of tornado in Bangladesh has attracted a great deal of attention from the world as severe local convective storms. In 2009 an international forum was held at Dhaka to discuss about counter measures of tornadoes. The approach to tornado mitigation is quite simple. Putting together an early warning system, structural strengthening of houses and the introduction of shelters on a domestic level (Mallick and Rahman, 2013). It is emphasized in the report of the forum that a community-based early warning system like CPP (IAWE 2009). In addition to build up the CPP-like organization by own experience Bangladesh can expect technological assistance for tornado forecast system from Japan.

Table 3. Worst 10 natural disasters in the two countries sorted by deaths

(1900-2013)[1,2]

Japan			Bangladesh		
Disaster	Date	Deaths	Disaster	Date	Deaths
Earthquake	09/1923	143000	Drought	1943	1900000
Earthquake	03/2011	19846	Epidemic	1918	393000
Earthquake	01/1995	5297	Storm	11/1970	300000
Earthquake	06/1948	5131	Storm	04/1991	138866
Storm	09/1959	5098	Storm	10/1942	61000
Storm	09/1917	4000	Storm	05/1965	36000
Storm	09/1945	3746	Flood	07/1974	28700
Earthquake	03/1933	3064	Storm	05/1963	22000
Storm	09/1934	3006	Storm	05/1985	15000
Storm	09/1923	3000	Storm	06/1965	12047

[1]EM-DAT: The OFDA/CRED International Disaster Daabase, [2]10 more killed/100 more affected/emergent declare/call international assistance, Earthquake includes tsunami, Flood includes storm surge, coastal flood, Storm includes cyclone, typhoon, local one.

Drought: Drought mainly caused by long period of dry weather is not a big problem in Japan because of abundant rainfall and forest coverage. Table 1, 2 and 3 show that the drought occurred only one time and very little number of deaths/sufferers during the last one hundred years. Drought, which had been known as one of main factors of agricultural damages in the past, was become to be controlled by water use-facilities made by the government with a large investment after the mid-*Meiji* era (Kaitani, 2013). And now it is said as a proverb that drought has no poor crop in Japan. Instead of drought which is not a big

problem in agricultural section, shortage of drinking and industrial water has become problems because of increased population in these days in Japan (Kotobank, 1998).

On the other hand, drought occurred 7 times and took a heavy toll of human lives in Bangladesh. Although table 3 shows 1,900 thousand people were killed in 1943 by drought, but it is doubtful that was caused by truly meteorological condition. One of famous historians wrote "famine of 1943 it was man-made disaster in that it was not a scarcity of food that caused so many to die but a collapse of the grain-marketing system (Shendel, 2009).

Drought mostly affects Bangladesh in pre-monsoon and post-monsoon periods to north-western region. From 1949 to 1979, the drought of 1957 which was one of the severest one affected 47% area of the country and the smallest drought in 1966 was 18%.To combat the drought, it is essential to utilize water resource for irrigation in Bangladesh like as Japan (Banglapedia, 2012). But it is a problem that they have to utilize surface water because of depletion of ground water resource as well as arsenic contamination. Surface water utilization projects such as barrages across the rivers, installation of pumping plants for lifting water from rivers are essential in Bangladesh (GoB. 2012)

Table 4. Natural Disasters in two countries (Economic damages)

1900-2013[1,2]

Disaster	Damage(billion $) (%)[6]	
	Japan	Bangladesh
Earthquake[3]	360(6)	0.5(1)
Flood[4]	12(0)	12(11)
Landslide	0.2(0)	-(-)
Storm[5]	57(1)	6(5)
Drought	-(-)	-(-)
Total	428.2(7)	19(17)

1.EM-DAT:The OFDA/CRED International Disaster Database
2.10 more killed/100 more affected/emergent declare/call international assistant
3.inc.TSUNAMI 4.inc.storm surge, coastal flood 5.inc. cyclone, typhoon, local one
6.Percentage of GDP(2011):Japan=5,867 Bangladesh=114 billion US$ (%)

Economic damages: Table 4 shows economic damages by five natural disasters and each number in parentheses shows percentage of economic damage to GDP in 2011 of each country. Table 5 lists worst natural disasters sorted by economic damages.

According to Table 4 amount of earthquake damage is the largest in Japan which is 6% of GDP. This can be understood by Table 5 which shows worst four damages are caused by the earthquake. The second largest damage is caused by storms and its amount is equal to one sixth of the damage by the earthquake. Damages caused by flood, landslide and drought are less than 1% of GDP.

Damage caused by flood is the largest in Bangladesh. Its equivalent amount of 12 billion US$ is 11% of GDP in Bangladesh and less than 1% in Japan. Second largest damage is caused by storms in Bangladesh and its amount is 5% of GDP. Totally, during the last hundred years,the amount of damage caused by natural disasters is 7% of GDP in Japan and 17% in Bangladesh.The amount of damage of Bangladesh is 2.4 times of Japan in the percentage of GDP although total real damage amount of Japan is 20 times larger than that of Bangladesh. The fact shows Bangladesh has not received bad influences at all economically, inferior to Japan.

Table 5. Worst 10 natural disasters in the two countries sorted by economic

1900-2013[1,2]

Japan			Bangladesh		
Disaster	Date	Damage (000 US$)	Disaster	Date	Damage (000 US$)
Earthquake	03/2011	210,000,000	Flood	07/1998	4,300,000
Earthquake	01/1995	100,000,000	Storm	11/2007	2,300,000
Earthquake	10/2004	28,000,000	Flood	06/2004	2,200,000
Earthquake	07/2007	12,500,000	Flood	06/1988	2,137,000
Storm	09/1991	10,000,000	Storm	04/1991	1,780,000
Storm	09/2004	9,000,000	Storm	05/1995	800,000
Flood	09/2000	7,440,000	Flood	08/1987	727,500
Storm	09/1999	5,000,000	Flood	07/1974	579,200
Storm	09/1990	4,000,000	Flood	09/2000	500,000
Storm	09/1998	3,000,000	Earthquake	12/2004	500,000

1.EM-DAT:The OFDA/CRED International Disaster Database
2.10 more killed/100 more affected/emergent declare/call international assistant
Earthquake includes TSUNAMI : Flood includes storm surge, coastal flood
Storm includes cyclone, typhoon, local one

Conclusion:

During the last hundred years, the storm and the earthquake occurred frequently and caused a lot of damages to human life and national economy in Japan. In contrast, the storm and the flood have been worst natural disasters in Bangladesh. Frequency of the storm in both countries are almost same but the number of deaths in Bangladesh are 18 times as much as that of Japan. Frequency and the deaths of flood in Bangladesh are larger than those of Japan although total amount of damage is equivalent. The economic damage of Bangladesh is 2.4 times of Japan in the percentage of GDP although total real damage amount of Japan is 20 times larger than that of Bangladesh. The fact shows Bangladesh has economically received bad influences not at all inferior to Japan.

Regarding Bangladesh, the disaster reduction policy of the present time has been made by the main stream of international ODAs and/or conferences. In the background of empowerment of women, community and the poor emphasized in the countermeasures, there were UN's millennium goals (2000), World Bank's poverty reduction strategy (2004), Hyogo (2005) and SAARC (2006) frame works for action. It can be said these agendas have connected the poverty and the disaster directly. Donor countries would request such kind of policy to the government as long as Bangladesh continues to be an aid receiver and she is obliged to meet expectation.

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