# Chapter 2
# Climate Change, Disaster Risk Management and South-South/Triangular Cooperation

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## 1. Introduction

The potential of South-South cooperation (SSC)/Triangular cooperation (TrC) in sharing knowledge and mutual learning is high. Not only has the South accumulated valuable experience in identifying and implementing development solutions, overcoming difficulties and constraints, the South and the North can collaborate to effectively manage the process of knowledge creation, knowledge exchange, capacity development and institution building to implement development solutions at scale. In particular, there are experiences that relate to managing new challenges of climate change adaptation and mitigation as well as prevention of natural disasters, and areas where the South and North are learning together to arrive at appropriate solutions.

Climate change adaptation and more effective prevention of natural disasters are new challenges for both the North and the South. However, the challenge for the South could be much greater, because the South has different constraints which are not necessarily found in the North such as availability of financial resources, appropriate technology and technical know-how, specialized professionals and trained personnel for disaster risk management (DRM), etc. For example, seismo-resilient transport infrastructure and houses are expensive. In developing countries, innovative solutions are needed to provide low-cost houses made of locally-available construction materials, which are affordable for low-income families. Similarly, these countries have to find ways and means to construct an infrastructure which is resilient to floods, landslides, earthquakes, tsunamis and other disasters, but at the same time affordable, with attention to the budget constraints of these countries' local and central governments.

From this point of view, SSC among developing countries prone to natural disasters could be an effective vehicle for mutual learning and co-creation of innovative solutions. Countries of the North could also cooperate with the South through triangular cooperation providing their own experiences of climate change adaptation and natural disaster prevention taking into account developing countries' local context.

This Chapter discusses the possibility of SSC/TrC in the area of climate change adaptation and disaster risk management (DRM). First, lessons from the Great East Japan Earthquakes and Tsunami and Thai flood that occurred in 2011 with be discussed (Section 1). Then, from the perspective of these lessons, the case of DRM in one of the most natural-disaster prone regions of the world, Central America, will be discussed (Section 2). The experiences of SSC/TrC based on the regional cooperation model of this region will then be analyzed (Section 3). New initiatives for more comprehensive climate change adaptation and disaster prevention will be discussed (Section 4). Finally, some conclusions will be presented.

## 2. Lessons from the Great East Japan Earthquakes and Tsunami and the Thai Flood[1]

The Japanese government considers it important that "Japan shares with the world lessons that have been learned based on the experience and knowledge gained from the Great East Japan Earthquake." [2] The recommendation of the Reconstruction Design Council in Response to the Great East Japan Earthquake issued in June 2011 entitled "Towards Reconstruction: Hope Beyond the Disaster," establish four pillars for recovery, one of which is "open reconstruction," referring to the belief that "our nation must strengthen its bond with the international community, and aim for reconstruction that is open to the world, rather than inward-looking." In that context, "it is necessary to share lessons Japan has learned from this experience with other countries, making them international public property. Japan has a duty to proactively contribute to the international community in the areas of disaster prevention and reduction in this manner in the future. Japan should utilize the lessons learned during the recovery and reconstruction process, and proactively promote international cooperation that values the bonds between people, through activities such as the development of

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[1] This section draws partly on the presentation made by Mr. Shinya Ejima, the Global Environment Department of JICA, in the occasion of Inter-American Development Bank (IDB) Meeting in March 2012. Errors and omissions are those of the author.

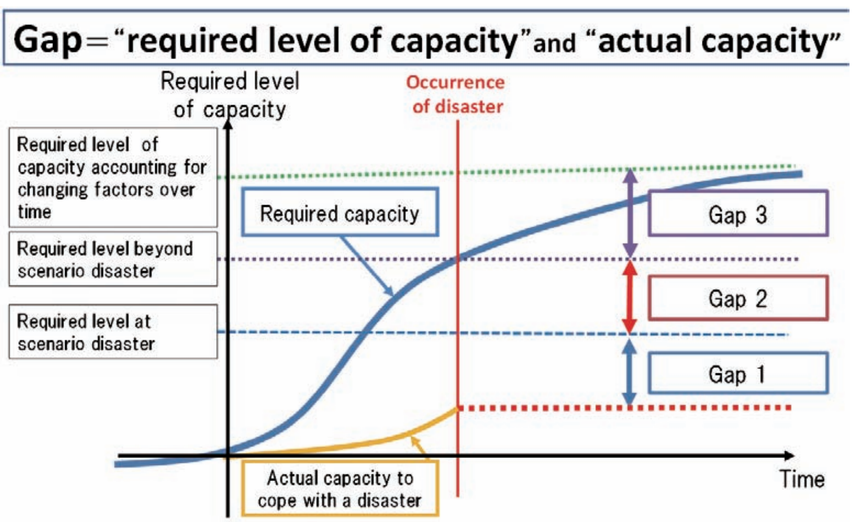
[2] Ministry of Foreign Affairs (Japan) (2011), p.16

human resources in developing countries in Asia and other regions.”[3]

One of the most important lessons learned from the Great East Japan Earthquakes and Tsunami and the Thai flood was the realization of the big gap between the required capacity of the country, society and people to cope with the disaster and actual capacity. The magnitude of this gap determined the damage caused by disasters.

What factors caused the gap? Based on case studies, we assume that there exist three kinds of required capacities to be considered depending on the severity of the disasters we face. The first one is the capacity for a scenario disaster. A “scenario disaster” refers to a disaster which is of a predicted magnitude and for which prevention measures had been taken in advance. However the capacity that a society actually has can

**Figure 1: Three Types of Gaps between Required Capacity and Actual Capacity**




Source: Based on Ejima, Shinya (2012)

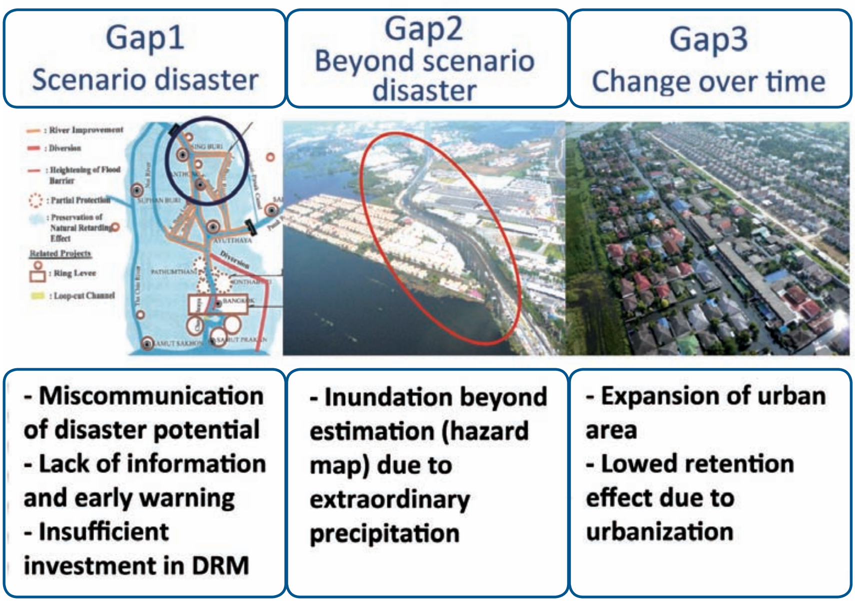
sometimes be smaller than what is required to cope with this kind of predicted “scenario disasters.” This gap is called Type 1 Gap. The second one, called Type 2 Gap, is the gap between the actual capacity a society has and the required capacity to cope with a disaster whose magnitude

[3] Ibid. p.16

happens to exceed the foreseen "scenario disasters." The last Type 3 Gap is the gap between the actual capacity a society has and the capacity level that has to be enhanced over time, to deal with the long-term changes that happen due to factors such as climate change, urbanization, population growth, etc.

These three gaps could be illustrated with the case of The Thai flood of 2011. As for the first gap, in spite of the scenario flood announced by the Thai government, some industrial estates are located in high-risk areas because owners and / or builders didn't understand the degree of damage possible and did not invest enough in disaster risk management for the potential severity of a flood. This was the Type 1 Gap.

**Figure 2: Three Types of Gaps in the Case of Thai Flood in 2011**




Note: Economic losses due to the flood in Thailand in 2011 are estimated to be 12.5 percent of the country's GDP.
Source: Ejima, Shinya (2012)

In terms of the Type 2 Gap, the flood happening in 2011 was much bigger than the prepared flood scenario. That is why some industrial estates which were outside the inundation area foreseen by a hazard map based on the scenario were affected by the flood. Here, we observe the gap between an extraordinary disaster scale and a scenario scale.

The Type 3 Gap is the gap developed over time. JICA supported Thailand to prepare a Master Plan for disaster risk management in the late 90's. However, Bangkok has very rapidly developed and urbanized during recent years. Therefore, it is necessary to take into account those changing factors in order to up-date the Master Plan. The Type 3 Gap is realized when changes over time are taken into account.

Based on the analysis of cases in which the three types of gaps occurred, the following measures taken appeared to be most appropriate to cope with each of them. Against the Type 1 Gap, which is the difference between recognition and reality, strengthening "Risk Literacy" should be effective. In many cases, people make judgments on their own and do not make efforts to evacuate. It is important to establish adequate communication at various levels in order to minimize the gaps between recognition and understanding risks. For instance, it is necessary to understand the limitation of structural and non-structural measures. In the Great East Japan Earthquake, there were cases where even municipalities that had issued a declaration (certificate) of safety suffered damage themselves. While one of the important roles of the public administration is to make residents feel safe, it is also important to make them aware of the limitations so that they can properly anticipate the risk of disaster. Communication is essential to ensure this awareness.

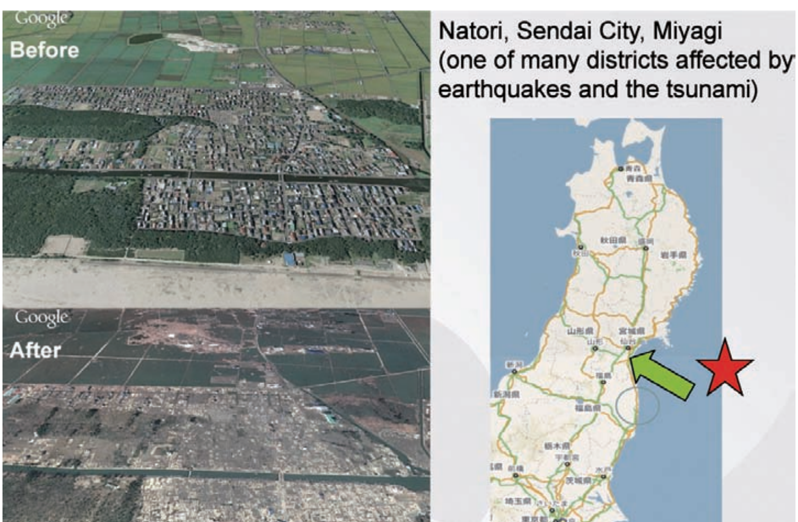
There are cases seen frequently around the world where the sense of crisis suddenly disappears, especially after the construction of a large-sized structure. However, there is a limitation to any kind of measure. It is essential to improve the disaster-reaction capacity by spreading this kind of information throughout the community.

The Type 2 Gap is caused because anticipating risk always involves uncertainty. This shows the importance of "Redundancy," such as building a multi-layered or combined capability for reacting to disasters. In various regions throughout the world, including Japan, people may feel a sense of excessive safety, with the introduction of a system based on leading-edge technology. However, we must also be aware of the limitations of such systems. When the Great East Japan Earthquake occurred, there were cases where information could not be transmitted because of a blackout. We must not forget that there are many kinds of potential risks, and sometimes redundant preventive measures may become necessary. In addition, it is also effective to establish multi-purpose measures by adding the aspect of disaster prevention to projects in different areas that are not originally aimed at disaster prevention.

We should not forget about redundant measures and operations for the future disaster risk management due to Type 2 Gap. Year 2011 had some extraordinary disaster events such as East Japan Earthquakes and Tsunami and Thai flood. In learning from these experiences, we should be better prepared with as many alternatives as possible by designing and operating preventative measures. To do so, we had better consider the importance of multi-functional and multi-sector disaster risk management. We can call this approach "Redundancy."

Victims of the Great East Japan Earthquake and Tsunami totaled 14,508 persons killed, 11,452 persons missing and 130,145 evacuees. It occurred at 14:46 on March 11, 2011. The magnitude of the earthquake was 9.0. It is estimated that the economic loss caused by the earthquake and tsunami was about 4% of Japanese GDP.

**Figure 3: Natori, Sendai City, before and after the Tsunami of March 11, 2011**




Source: Ejima, Shinya (2012)

Lastly, regarding the Type 3 Gap, we need to recognize that even if we finish measures based upon an expected situation, such measures don't provide a permanent solution. Circumstances change daily. For example, the international community has been discussing climate change and its impact lately. So we need to continue reviewing various counter-measures, taking into account changing factors such as climate change, urbanization and social factors. In order to address this type of gap, an effective measure could include efforts toward continuous improvement or "*Kaizen*".

Various kinds of disaster prevention measures have been taken in many countries, and promoted under the Hyogo Framework for Action (HFA). However, disasters such as the Great East Japan Earthquake and the Thai flood are revealing the fact that various countermeasures may not necessarily work as expected, and may not result in reducing risks.

In order to fill the various gaps explained so far, and to implement better Disaster Risk Management, we believe that it has become important to have the guidelines based on lessons learned from the recent great disasters in Japan and Thailand combining the three perspectives, namely "Risk Literacy," "Redundancy" and "*kaizen*," keeping in mind the comprehensive disaster risk management strategy.

## 3. South-South and Triangular Cooperation for Disaster Risk Management in Central America

Central America is a disaster prone region, and the countries of the region have been making concerted efforts to reduce disaster risks through a regional cooperation mechanism of the Center of Coordination for the Prevention of Natural Disasters in Central America (CEPREDENAC). One of the projects based on the above-mentioned approaches discussed in the Section 1 is the Project on Capacity Development for Disaster Risk Management in Central America, or the "BOSAI Project." In this project, JICA supports capacity development to promote community-based disaster risk management in six countries in Central America with the framework of region-wide cooperation under the CEPREDENAC, which is one of the specialized regional cooperation mechanisms under the auspices of Integration System of Central America (SICA).

The overall framework for this region-wide cooperation initiative was established by the Tokyo Declaration of Japan-SICA Summit in 2005. It included a region-wide cooperative effort for the fight against Chagas disease, better mathematics education, natural-disaster prevention, improved re-productive health, quality and productivity improvements, and other initiatives. Governments of Costa Rica, Honduras, Guatemala, El Salvador and Panama submitted official requests to Japan for technical cooperation with regard to local disaster risk management in 2006. Based on this initiative, management authorities of the above five countries, CEPREDENAC and JICA launched "BOSAI Project" in 2007. Nicaragua joined the Project in 2008.

**Figure 4: Location of Communities of BOSAI Project**

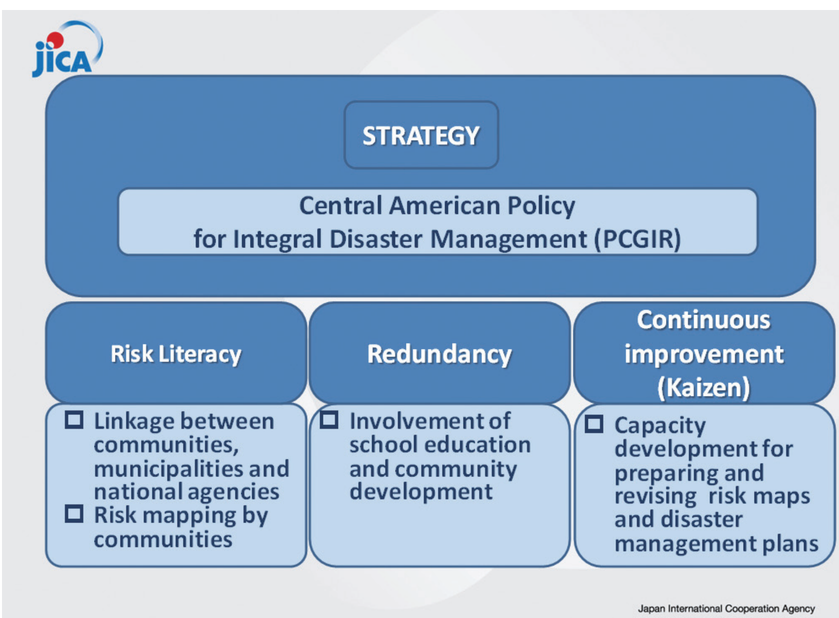
Source: Arakida, Masaru (2009)

The heads of states of member countries of the Central America Integration System (SICA) adopted, on October 30, 2010, the Central American Policy of Integrated Disaster Risk Management (PCGIR), in order to respond to the need to update the regional commitments designed to reduce and prevent the disaster risk and thereby contribute to an integrated vision of development and security in Central America. The PCGIR highlights the importance of developing local capacity to reduce risk and to respond to disasters by strengthening the autonomy and resilience of communities. BOSAI has constituted an important pillar in the implementation of the PCGIR.

The regional progress report of the Hyogo Framework of Action (HFA) on Central America, updated April 2011, referenced two indicators for HFA priorities in relation to the local disaster risk management: "Sub/regional early warning systems exist" and "Sub/regional information and knowledge sharing mechanism is available." One of the aspects which should be highlighted among the achievements of BOSAI is its contribution to the progress towards achieving these regional indicators of HFA.[4]

As for Risk Literacy, BOSAI focuses on helping the residents fully understand the risks of their own community and take actions on their own by maintaining reliable communication between the communities, municipalities and national agencies, and at the same time by letting the communities implement risk mapping through repeated discussions and site inspections.

**Figure 5: Project on Capacity Development for Disaster Risk Management in Central America (BOSAI Project)**




Source: Ejima, Shinya (2012)

[4] Bosai Terminal Evaluation Team (2012) p.9

From the perspective of redundancy, the project also approaches other sectors through activities to promote the awareness on disaster prevention by means of school education, and by incorporating collaboration with the development committees of the community.

From the perspective of *kaizen*, capacity development aims to let the community prepare risk maps and disaster management plans, and improve them on its own. Capacity development, both at community and local government levels, strengthened their ability to effectively respond to various disasters including earthquakes, flooding and landslides and to take concrete action such as the development of hazard maps, early warning systems, disaster prevention plans, and innovative practices to prevent landslides, flooding, etc.

## 4. Mutual Learning and Co-creation of Innovative Solutions in the Capacity Development Process for the Prevention of Natural Disasters

Since commencing in 2007, the BOSAI Project was implemented according to its Master Plan and Annual Plans of Operation (APOs). While the Master Plan is common to all participating countries, APOs are prepared by each participating country in accordance with the master plan. The Project Design Matrix, which is the framework for project implementation and evaluation tool, was also prepared based on the master plan. There are three indicators set in the Project Design Matrix to be used to evaluate the level of attainment at the project purpose level: (1) The first indicator is the reduction of vulnerability to disasters in target communities; (2) The second indicator is the strengthening of disaster risk management in the target municipalities; (3) The third indicator is the improvement of knowledge and ownership regarding local disaster risk management of CEPREDENAC member national institutions. According to the Terminal Evaluation Report of BOSAI, the targets of the first and second indicators were achieved 68% and 90% respectively. As regards the third indicator, the target was achieved fully in 3 national institutions and significant advances were attained in 3 other institutions.[5]

The first target is related directly to the communities' capacity development (CD). Major achievements at the community level include

[5] Ibid. pp.10-11

the development of organizations, risk maps, evacuation routes, early warning systems and emergency response plans. Some communities in Panama, Costa Rica, Honduras and El Salvador constructed small mitigation works such as used-tire dykes and retaining walls as well as attaining remarkable involvement and commitment in voluntary labor. Although there have been many important cases of successful capacity development in which effective mutual learning and co-creation of innovative solutions have taken place, one of the most outstanding cases could be that of used-tire dykes. We will therefore focus on this case.

In a rural community called Barrio Hotel near the city of Cañas, Costa Rica, community members developed a hazard map related to the flood of the Cañas River and, based on the map, established an early warning system (SAT) consisting of rain gauges and warning sirens, before starting the pilot project of a used-tire dyke.

**Figure 6: Target Area of Community Flood Warning in Costa Rica**


Source: Oi, Hidetomi (2006)

After exchanging ideas among community members and JICA, represented by Mr. Horigome, a civil engineering specialist, they started to explore the possibility of utilizing used tires from a sugar cane plantation nearby for the construction of dyke to reduce the risk of flood of the Cañas River. Many of the community members were workers on this plantation and were aware that the company had difficulties in disposing of used tires. They thought these tires could be used for construction of dykes, but lacked the technical know-how. JICA specialists provided information regarding successful experiences in a country where used tires were utilized to strengthen river bank protection. Community members, the CNE (Comisión Nacional de Prevención de Riesgos y Atención de Emergencias) project manager and Mr. Horigome made a careful study on where dykes should be constructed.

We can recognize clearly that through this process of capacity development, effective mutual learning and the co-creation of innovative solutions among stakeholders was achieved. As the construction of new dykes with used tires is practically the first experience in history, a very careful approach was adopted. It was decided to first carry out a pilot project in order to establish the proper methods of design and

**Figure 7: Construction of Used-tire Dyke in Costa Rica**

Source: Kawahigashi, Eiji (2011)

construction. Community members were to participate in the construction work in shifts. These decisions were made by community members. They also negotiated with the sugar cane plantation company to provide used tires. The City of Cañas and the BOSAI project provided other construction materials. The construction of the pilot dyke was 23 meters in length, 2.1 meters in width and 90 centimeters high. It was started on April 27 and finished June 12, 2009.

Based on the experience of the pilot dyke, a plan to expand it was proposed by Professor Yamamoto of Hiroshima University sent by JICA as a disaster prevention specialist in January 2010. A dyke of 116 meters, which constitutes the first part of the plan, was constructed by community members with the collaboration of CNE and the City of Cañas in February and March 2011. A technical check of this new dyke was made by Professor Yamamoto.

Similar projects were implemented in other parts of Central America.

**Figure 8: Construction of a Used-tire Retaining Wall to Avoid Land Slides in Honduras**

Source: Kawahigashi, Eiji (2011)

In the BOSAI Project, there have been several other cases of the co-creation of innovative low-cost solutions to reduce the vulnerability to disasters in the target communities and to strengthen their disaster preparedness. Installation of rainfall equipment (rain gauge, fluviometer) with the alarm unit for community-operated flood warning and water glass (water level monitor) with automatic warning systems are some of examples.

**Figure 9: Water Glass (Water Level Monitor) with Automatic Warning System in Guatemala**

Source: Oi, Hidetomi (2008)

## 5. Achievements at the National Level and Regional Scaling-Up through South-South and Triangular Cooperation with Regional Support

According to the evaluation related to the strengthening of the mechanisms for disaster risk management, based on interviews conducted in 50 communities out of the target 62 communities of the BOSAI project, 96% established a disaster risk management organization, 88% prepared a risk map, 66% set-up the communication systems, and 88% developed a disaster response plan. Regarding the promotion of knowledge or awareness on disaster risk management in target communities, 66% held workshops or events in communities and 60% conducted evacuation drills.

Based on the experiences of the targeted communities, national scale-up processes have taken place in each country. The installation of rain gauges for early flood warning extended beyond the targeted communities in El Salvador. A plan to set up warning sirens in more than 150 communities is in force in Tegucigalpa, Honduras. The Frog Caravan is one of the successful activities of the BOSAI Project in that the practice extends well beyond the target communities[6]. The Frog Caravan was also conducted by

**Figure 10: An Early Warning Siren in the Las Hojas Community, El Salvador**

(Above)
House destroyed by Hurricane lda in Las Ojas community in November 2009

(Below)
One of the nine flood early warning sirens in the Las Hojas community

Source: JICA El Salvador Office

[6] Frog Caravan (Caravana de Rana) is an innovative training system to learn about natural disaster prevention developed by a Japanese NPO, Plus Arts (+Arts), in 2005. In Japan the frog is considered a friendly symbol promoting good feelings and Frog Caravans tour schools, involving local officials, teachers and schoolchildren, and introduce for example games for teaching children how to extinguish fires or rescue people trapped under rubble in the wake of an earthquake.

other donors, and in Guatemala it is now planned to incorporate the Caravan into a school curriculum. A plan to extend the Frog Caravan nationwide has been implemented in Guatemala and Panama.

The impact of the BOSAI project has been recognized in some natural disaster events. When Hurricane Ida slammed into El Salvador in November 2009, it triggered massive flooding and landslides and more than 300 persons were killed or went missing. However, in the coastal village of Las Hojas there were no deaths and an investigation attributed this at least partly to the fact that a disaster early warning system had been installed there by JICA. In the very early morning of November 8, the disaster committee of San Pedro Mashuat received the information of extraordinary rainfall with water levels beginning to rise dangerously from the upstream communities of Jiboa River.
This information was transmitted to the village disaster prevention

**Figure 11: Las Hojas Community after the Hurricane Ida**

Note: Red circle indicates one of the early warning sirens
Source: JICA El Salvador Office

committee of Las Hojas via a JICA donated wireless system. Nine alarm sirens were sounded throughout the village two hours before the flood allowing local residents to quickly flee before floodwater could engulf them. The establishment of disaster prevention committees and the installation of wireless transmission systems and nine alarm sirens were part of the BOSAI project. The survey conducted in 2010 discovered that 50 percent of 94 families of the community evacuated when they heard the siren and that 37 percent knew about the BOSAI Project.

During tropical depression 12E in October 2011, there were no casualties in the BOSAI Project target areas in El Salvador. When a survey was made in December 2011 in San Pedro Mashuat, where significant damage occurred during storm 12E, inhabitants expressed their gratitude for the BOSAI Project that there were no casualties thanks to early evacuation practice.[7]

One of the pioneer municipalities of the BOSAI Project in El Salvador, Santa Tecla, participated in February 2011 as the sole local government representative community of Central America in the Thematic Debate of the United Nations General Assembly on Disaster Risk Reduction which aimed to strengthen the understanding of how to reduce risk and exposure to disasters through effective investment policies and practices and sustainable urban management. Santa Tecla received recognition as the "Role Model for Participatory and Sustained Risk Reduction Policy" of the "Making Cities Resilient Campaign" in the Third Session of the Global Platform for Disaster Risk Reduction, organized by the United Nations in Geneva in May 2011.

According to the Mayor of Santa Tecla, Oscar Ortiz, strong awareness and motivation of this municipality on disaster prevention is due to the tragic consequences of a landslide caused by the big earthquakes in 2001. The landslide took the life of 700 inhabitants. It was difficult to reconstruct communities seriously affected by the earthquakes. The municipality put the highest priority on disaster risk management since this tragedy occurred. He considers the keys to the successful process, recognized by the United Nations, was the trust of the inhabitants through a participatory approach, education and local government leadership with medium and long term vision. Santa Tecla's experiences and know-how are shared with other Central American countries. The rain gauges (fluviometer) introduced by Yayoi Yoshioka, a volunteer of JOCV for the first time in the municipality are still in use for early warning of floods. The BOSAI Project has been effective and the municipality learned a lot from the Hyogo Phoenix Plan.[8]

7 Terminal Evaluation Team (2012), p.13

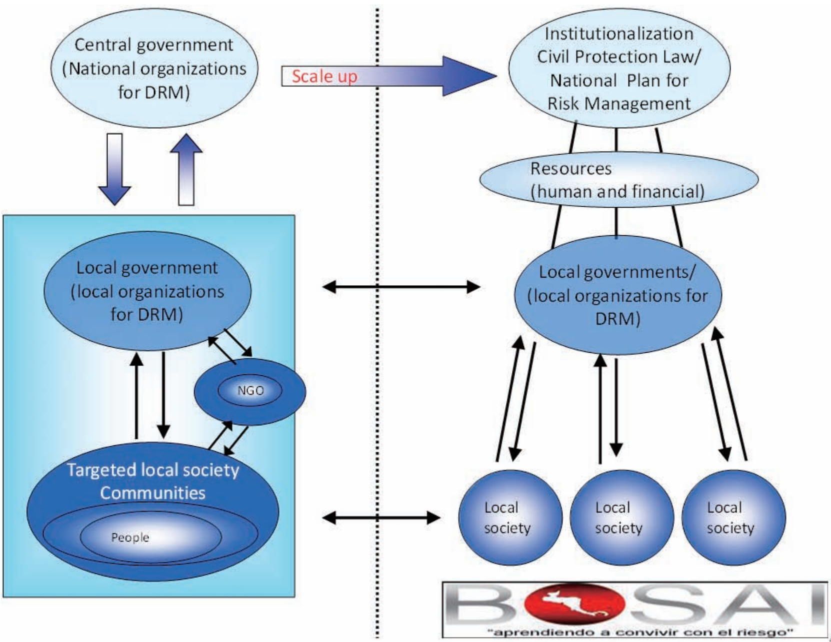
8 This part of the experiences of Santa Tecla is based on the author's interview with its Mayor, Mr. Oscar Ortiz on August 28, 2012.

**Figure 12: Landslide at Las Colinas, Santa Tecla, El Salvador in 2001**

Source: Oi, Hidetomi (2008)

Several national scale-up initiatives of the BOSAI Project have been carried out. In El Salvador, the Civil Protection Authority has assigned 178 municipal delegates ("Delegado en Municipio") and 19 department delegates ("Delegado en Departamentos") in accordance with the Law of Civil Protection, Prevention and Mitigation of Disasters enacted in 2005. These delegates facilitated the establishment of the Municipal Commission of Civil Protection (CMPC). The National System of Civil Protection (SINAPROC) in Panama has increased the number of staff at a provincial level with the assignment of a national agent ("Punto Focal Nacional") and provincial agent ("Punto Focal Provincial), who are engaged in the coordination with municipalities/communities to promote the integrated local disaster risk management. The Permanent Commission of Contingencies (COPECO) of Honduras through its seven regional offices is promoting the establishment of Emergency Committees at different levels (departments, municipalities, communities, schools and working centers). As of the end of 2011, 150 out of 298 municipalities have established Municipal Emergency Committees (CODEM). Also 325 Local Emergency Committees at community levels have been organized. The BOSAI Project has been contributing to the institutional strengthening of these organizations through activities specifically targeting municipalities and communities.

**Figure 13: CD Pathways for Innovative Practices to Scaling Up in the Case of BOSAI Project (examples)**




Source: Prepared by the author

National legal and/or regulatory frameworks have been established or will be in force soon. The Civil Protection Law for Prevention and Mitigation of Disasters in El Salvador, the National Policy for Integrated Risk Management in Panama, the National Plan for Risk Management in Costa Rica and the National Policy for Disaster Risk Reduction in Guatemala are already in force. The National Policy for Integrated Risk Management in El Salvador and the National Plan for Risk Reduction as well as the National Policy and Strategy for Integrated Risk Management in Nicaragua, the Law of National Systems for Risk Management and the National Plan for Integrated Risk Management in Honduras are in the approval process. These legal frameworks are appropriate and instrumental in promoting the scale-up of local risk management to a nation-wide level.

From the South-South/Trangular cooperation perspective, exchange of experiences, knowledge and know-how related to disaster risk management is actively promoted through CEPREDENAC. The capacity of CEPREDENAC itself has been strengthened during the BOSAI Project. In the BOSAI Project, methodologies and tools commonly applicable in Central America were developed based on the different experiences of member countries, producing a series of practical materials including a manual of hazard-map based trainings, manuals of production and use of a rain gauge, and of water glass, construction guides for used-tire dykes, and of soil cement dykes, prevention kits for disasters caused by volcanic eruptions, Frog Caravan manuals, DIG (disaster imagination game[9]), SAT (Sistema de Alerta Temprana, early warning system) guidebooks and so on, which are now publicly available in member countries.

Regional workshops have been held using developed methodologies and tools. Through regional meetings and in day-to-day communications among national member institutions of BOSAI, there have been effective exchanges of experiences, technology and know-how, which constitute the South-South cooperation of knowledge sharing and mutual learning. This process developed in the regional platform, CEPREDENAC, with cooperation of JICA could be considered as a case of region-wide South-South/Triangular cooperation.

CEPREDENAC received in the Third Session of the Global Platform for Disaster Risk Reduction in May 2011, the UN Sasakawa Award for Disaster Reduction for its contribution to regional efforts for formulating disaster prevention strategies and national plans based on Central America Policy of Integrated Disaster Risk Management (PCGIR). It was prepared by CEPREDENAC and approved by heads of states of Integration System of Central America (SICA).

One interesting achievement of South-South/Triangular cooperation in the framework of BOSAI is that it constructed a community shelter house in collaboration with another SSC project in Central America, the TAISHIN project. The TAISHIN Project aimed at strengthening earthquake-resistant housing in El Salvador from 2003 through 2012.[10] The shelter house was constructed in the Metapalos Arriba community in Triunfo municipality, Cholteca, Honduras. The house was based on the structural engineering research using a large-scale structure testing laboratory to study the seismic

9 DIG (known in BOSAI Project as "El taller de Metodologia Komura) is the methodology developed by Professor Takashi Komura, of the Fuji Tokoha University, Japan.

10 For details of TAISHIN, see the case study on this Project included in this volume.

behavior of structures made of frame and sun-dried brick or adobe (a locally available low-cost material). These are the most common building types found in Mexico, Central America, and the Caribbean.

BOSAI Project in the Metapalos Arriba community started June 2008. The construction of the community shelter house was the plan proposed through the mutual learning process similar to that of the community near the City of Cañas, Costa Rica explained in the Section 2. Community members, JICA professionals including Mr. Horigome and Mr. Kinoshita as well as other stakeholders had several meetings. Through this process, it was decided to construct the earthquake resistant low-cost house ("casa de sismoresistente con abobe reforzado) with the use of the technology developed by the TAISHIN Project in El Salvador.

The municipality provided a fund to buy the land. More than 6000 adobes were made by inhabitants themselves using the most inexpensive locally available material. This construction project was important for community members, because it gave them the opportunity to enhance their awareness of and capacity for disaster risk management and to learn about the construction methods for building seismo-resistant houses. The synergy effect of the BOSAI and TAISHIN projects was attained through SSC/TrC in this community shelter housing construction project.

**Figure 14: Centro Albergue (a Community Shelter House) in the Metapalos Arriba Community in Cholteca, Honduras.**

Source: JICA El Salvador Office

## 6. A More Comprehensive Approach to Disaster Risk Management in Developing Countries.

In order to formulate a comprehensive approach to disaster risk management in developing countries, the following three aspects appear to be crucial, bearing in mind experiences of recent natural disasters and of international cooperation in developing countries. First of all, the importance of both risk prevention and reduction as is mentioned in the "The recommendation of the Reconstruction Design Council in Response to the Great East Japan Earthquake" cited in the Section 1 of this Chapter must be considered. Secondly, it is necessary to take into account changes of risk over time taking into account the effects of climate change, urbanization and so on. These changes could produce the Type 3 Gap as discussed in the Section 2. Thirdly, in the case of developing countries, affordability by governments, communities and inhabitants should be fully taken into account.

Generally speaking, the main aspects of a standard framework of risk management are risk avoidance (or prevention, Bosai), risk reduction (Gensai) and risk transfer (insurance). In the risk avoidance (or prevention) area, in addition to a strengthened capacity for disaster risk management, quality standards of public works, seismic building codes and land use regulations are important. In the risk reduction (Gensai) area, pre-disaster investment and seismic reinforcement construction are essential.

In an effort to support risk reduction efforts of El Salvador, a new cooperation project called GENSAI started recently. The tropical cyclone 12E seriously affected El Salvador, due to historically high continuous rainfall and caused severe damage to social and economic infrastructure in the country. Not only did 12 bridges collapse, 37 bridges were damaged seriously, landslides and road slope failures were observed at many sections along roads including major highways. Disasters caused by rain in El Salvador have become more frequent and serious recently. Hurricanes Mitch, Stan, Ida and tropical cyclone 12E brought heavier continuous rainfall.

In these circumstances, the Department of Climate Change Adaptation and Strategic Risk Management (DACGER) was newly organized under the Ministry of Public Works, Transport, Housing and Urban Development (MOP) of El Salvador under the Minister's direct control in 2008. With this initiative, the government of El Salvador made the promptest response to climate change in Central American countries. With these provisions, government efforts proved highly capable during the restoration works for 12E. Heavy equipment consisting of 142 heavy machines for reconstruction granted by the Japanese government in 2010 was effectively utilized during the restoration work. With this experience and in response to the request from the MOP, the Japanese government decided to carry outthe Economic Infrastructure Rehabilitation Project in 2012. And, almost at the same time, in order to strengthen the capacity of disaster reduction regarding pre-disaster investments and seismic reinforcement construction, the GENSAI Project has started with the cooperation of JICA.

The aims of the GENSAI Project to be implemented between 2012-14 in El Salvador are: (1) to establish a structure in the MOP which promotes the implementation projects of improvement of public infrastructure in accordance with the priority recommended by DACGER; (2) to establish a system which rapidly and adequately prepares an inventory of damages and implements reconstruction work when natural disasters occur; and (3) to establish a national training system for national engineers in charge of public infrastructure.

The GENSAI Project includes grant provisions for equipment and technical cooperation for reinforcement of public infrastructure for climate change adaptation as well as education for disaster prevention.[11]

In this way, now a more comprehensive approach to disaster risk management has been adopted in El Salvador. The goal of the GENSAI Project is to strengthen the infrastructure to protect the lifelines of inhabitants. On-going BOSAI and TAISHIN Projects are expected to produce synergy effects with GENSAI Project making the capacity to address the risk of natural disasters much more integral and effective.

It should be emphasized that specific, technologically and financially feasible options are essential in developing countries. Fiscal and other constraints of these countries' central and local governments and the low-income of the most affected inhabitants of the country should be

[11] Mikihiro Mori (2012)

**Figure 15: GENSAI Project Brochure**


Source: JICA El Salvador Office

fully taken into account. In the case of the BOSAI project in Central America, used tires are utilized to reduce the risk of land-slides and floods, etc. This innovative practice has been applied in Honduras, Costa Rica and El Salvador, using locally available low-cost materials. Another example is an inexpensive community flood early warning system with rain gauges and water glass.

As was mentioned in the previous Section, low-cost earthquake-resistant housing is another example. JICA started cooperation for CENAPRED, Mexico after the big earthquake in the central part of Mexico in 1985. The technology and innovative methods developed by CENAPRED have been used in the TAISHIN Project, aimed at furthering earthquake-resistant housing in El Salvador from 2003 through 2012. Then, experiences and innovation in the joint TAISHIN Project CENAPRED/ JICA/Japan Institute of Construction/El Salvador were shared with Central America and other Latin American countries through the Japan Mexico Partnership Program (JMPP), as a South-South/Triangular cooperation project.

According to a study of the two large earthquakes that hit El Salvador in 2001, 60% of the houses destroyed were those of poor people whose income was less than twice the country's minimum wage. Houses made of improved adobe, soil cement, block panel, and concrete block were tested with their respective appropriate structures in the Large Structure Laboratories installed in the University of El Salvador and the Jose Simeon Cañas University of Central America. This Mexico-Japan-El Salvador South-South/Triangular project included the establishment of official technological standards for earthquake-resistant houses and institution buildings for the governmental urban and housing development agencies in charge of housing policies and construction permits.

Finally, it should be noted that further effort is necessary to address disaster risks especially in poor urban districts. Half of the global population resides in urban centers and urbanization is accelerating in developing countries. A close correlation is observed between urbanization and the number of natural disasters. The possibility of a "Type 3 Gap" increases due to rapid urbanization. Possibility of another "Type 3 Gap" increases as well due to climate change (floods, etc.). Furthermore urban slums have been expanding in risk areas in the case of many developing countries. Today, there are a billion people living in urban slums. We need to focus on disaster prevention for the urban poor.

In many developing countries, urban sprawl, slums and inadequate infrastructure provision are commonly observed in the process of urbanization. Programs of "urban redevelopment" with land readjustments could be an effective approach to address urban poverty, slums and disaster prevention. After urban areas are subdivided and settled, whether legally or illegally, it is extremely difficult to re-arrange property patterns, and it is both difficult and expensive to assure land for proper public purposes and facilities. Land readjustment is a public-private partnership model, which local governments, residents and landowners bearing the urban development costs and sharing benefits in places where land use patterns are inadequate and/or risky. Normally every transformed lot will be smaller than the original one due to the significant increase in public spaces, but lot value will be higher due to the added facilities as well as to improved safety and disaster prevention.[12]

[12] De Souza, Felipe Francisco and Cintia Estefania Fernandez (2012)

JICA has been supporting land readjustment initiatives in Sao Paulo and Curitiba, Brazil, and other developing countries. Several training courses to share the knowledge about land readjustment have been carried out in Brazil, Colombia and other countries through South-South/Triangular cooperation. Better urban land use taking into account risk areas should be one of the most important measures to avoid disasters.

In addition to different programs and projects of cooperation mentioned through this chapter in the area of disaster risk management, JICA independently and through the Japan Disaster Relief (JDR) system for years has helped nations and victims of natural disasters, offering emergency supplies and follow-up assistance to countries affected by natural disasters including Central American countries.[13]

## 7. Concluding Remarks

The current international framework for promoting the disaster prevention measures throughout the world is called the "Hyogo Framework for Action (HFA)" This is the document adopted at the Second United Nations World Conference on Disaster Reduction in 2005 by 168 participating countries, under the initiative of the UN International Strategy for Disaster Reduction (ISDR). It is the guideline showing the goals and prioritized actions in the area of disaster prevention throughout the world for the ten year-period from 2005 to 2015.

Interim evaluation of the Hyogo Framework of Action was implemented last year. From now on, along with aiming at the achievement of goals towards 2015, discussions will begin on the new post-2016 framework.
Lessons learned from Great East Japan Earthquake and Tsunami on March 11, 2011 and from other recent disasters as well as international efforts to prevent and reduce disaster risks, including South-South/ Triangular cooperation to enhance the capacity of disaster risk management in Central America, one of the most natural disaster fragile

[13] In the last 10 years it implemented a series of disaster prevention projects (technical cooperation) costing 47.33 billion yen (500 million US dollars) in 147 countries. Grand aid projects totaling 38.15 billion yen (450 million US dollars) were implemented in 27 countries including the procurement of weather reader systems, radar, shuttle, construction of emergency evacuation centers and the rehabilitation of basic infrastructure such as schools, hospitals and water supply facilities. Financial cooperation (yen loan) totals 463.14 billion yen (5.7 billion US dollars) in 13 countries for urban drainage, river improvement, multi-purpose dam, etc.

regions in the world, should be reflected in this new post 2016 framework.

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