

# Safer Cities 10

Case studies on mitigating disasters in Asia and the Pacific

## Creating Earthquake Preparedness in Schools A Case Study of Mitigation Efforts in Indonesia

### Introduction

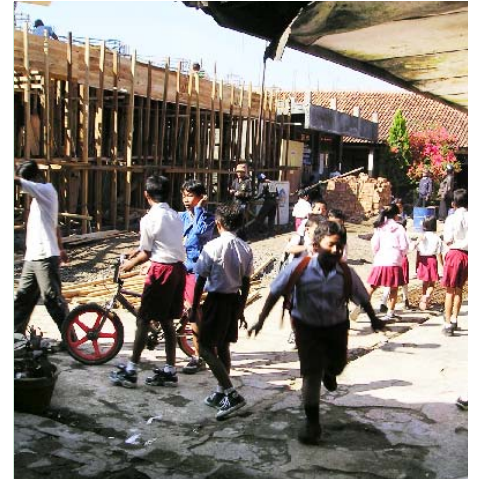
The city of Bandung rests in the basin of a former lake in the shadow of active volcanoes and mountain tops. Bandung is host to a multitude of important government agencies, educational institutions, and industries. As the third largest city in Indonesia, Bandung is an important industrial city noted for its burgeoning textile industry. The majority of Indonesian textile is made in West Java, and two thirds of this production occurs in Bandung making the city an important outpost of the economy.



A street vendor in downtown Bandung

As is characteristic of any bustling metropolis, there is a focus on the here and now. The factory outlets do their daily business, the street vendors sell typical Indonesian delights of Nasi Goreng (fried rice) and various forms of Ayam (chicken), bands of youth make their living strumming their guitars and wooing traffic jammed cars in hopes of making a few hundred Rupiah, and the groups of students make their way to school every morning.

In a country still trying to forge a healthy economy the role of a major city will indeed be focused on more immediate matters relating to peoples' livelihoods. However, beyond the horizon there looms the potential for a fatal disaster.



Children play amongst school building construction at SD. Tikutpur

### Abstract

This case study focuses on the experiences of implementing earthquake hazard mitigation to make school communities safer in Bandung, Indonesia. It highlights the Indonesian Urban Disaster Mitigation Project (IUDMP) implemented between 1997 to 2003. The project has carried out a school preparedness program and a school retrofitting program within its mandate. This case study also considers possible partnerships and efforts for the future of creating safer school communities a sustainable endeavor.

### The inside story

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- ☞ Earthquake Preparedness and the Dissemination of Information in Schools
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- ☞ Information Products of IUDMP
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## A Potential Disaster

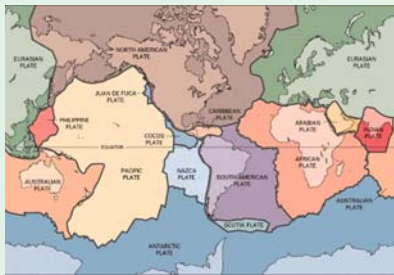


Earthquakes are one of the worst geological threats to the Indonesian region. The geodynamic positioning of the Indonesian islands within the zone of the Australian plate, the Eurasian plate, the Pacific plate, and the Philippine plate makes the country amongst the most seismically active countries in the world. The major fault systems in the area are the Sunda Strait Fault, the Indian Ocean Subduction Fault, the Baribis Fault, and the Cimandiri Fault. The visible Lembang Fault within Bandung makes this city vulnerable to great catastrophe.

The lack of guidance and control to urban development schemes has led to the expansion of the city into more seismically prone areas. The implementation of building codes to ensure earthquake safety has not been effective. Critical facilities such as hospitals and schools are at the greatest risk of collapse due to inappropriate construction.

### Explaining Earthquakes

*Plate Tectonics* is a theory that provides a framework for understanding the earthquake phenomenon. The outer layer of the earth's crust is broken into a mosaic of slabs called plates. The plates are cohesive rock masses ranging in thickness from 30 to 50 km and having widths of tens of thousands of kilometers. These plates move continuously- either converging towards one another, or diverging away from one another, or sliding past one another, at rates ranging from a fraction of a centimeter to several centimeters per year. The slow, ongoing, plate-to-plate interactions produce the majority of the world's earthquakes and volcanoes.



**Map of the major tectonic plates in the world**

<http://geology.er.usgs.gov/eastern/plates.html>

*Faults* are rifts in the Earth's crust along where two fractures of the crust have slipped with respect to each other.

Bandung is in close proximity to the Lembang Fault and the volcanoes of Mt. Galunggung, Mt. Patuha, and Mt. Burangrang.



*Volcanic crater at Mt. Galunggung*

Bandung's high population density is what makes this city one of the most vulnerable to earthquake disasters in Indonesia. For a city that was initially earmarked for only 500,000 people, by the year 2010 Bandung will be home to approximately 7 million people. This large population size elevates the risk of an earthquake in Bandung.

Unknown to the majority of the city's population, the soil conditions of the prehistoric lakebed on which Bandung sits increases vulnerability from earthquake impact. The region's soil is formed by depositions of alluvium. This is soft soil, which makes the area more susceptible to the impact of shock waves generated during an earthquake. The head of Volcanology and Disaster Mitigation, Department of Geology, Dr. Surono, explains, "Sedimentation in this area is very thick and usually earthquake magnitude is very high, especially for the island of Java. The impact is higher when there is soft soil. In Java there are many problems because 60% of the Indonesian population lives here. That is 220 million people. If an earthquake occurs in Java with a magnitude between 4.8 – 5.2 on the Richter scale, the structure of traditional houses will collapse."

### The Bandung Earthquake Scenario (Predictions of a 200 year periodical earthquake)

According to the Risk Assessment Tools publication by the RADIUS project (Risk Assessment Tools for Diagnostic of Urban Areas against Seismic Disasters), experts assume that serious damage and collapse will take place in Bandung if there is a strong earthquake. The region with the highest intensity is subdistrict Cibiru and the lowest intensity area where ground acceleration may meet 0.238 gravitation is subdistricts Cibeunying Kaler and Cibeunying Kidul. Investigations suggest that the number of victims will be as high as 2,600 people. The percentage of people losing their settlements due to building collapse and damage will be 60% in downtown Bandung and 20% in rural areas. The railway, electricity networks, and clean water sources will be severely damaged. Cibeunying region, which has the densest traffic, will experience the worst road damage. In the Tegallega, Cibeunying, and Bojonegara areas, bridge damage will also be grave. This will jeopardize the ability for other areas to bring in help to Bandung.



Havoc caused in a school building by a devastating earthquake that hit Bengkulu in 2000.

Unlike more pronounced disasters that Indonesia faces, such as landslides, floods, and hurricanes- the preparation for an event that is unpredictable and rare is low on the agenda of city officials. Overall, there is great negligence of the risk that earthquakes pose to the city of Bandung.

### Assessing Risk

The first step for implementing mitigation techniques is to carry out basic intensity zoning mapping and risk assessment. This allows any selected area to be delineated into high, medium and low seismic hazard zones, and to assess vulnerability. Thereafter possible damage and loss is assessed in risk assessment. The two processes lead to mitigation planning that is relevant to each delineated zone.



## Mitigation of an Earthquake Impact



The Indonesian Urban Disaster Mitigation Project (IUDMP) was launched in 1997 under the Asian Urban Disaster Mitigation Program (AUDMP) of the Asian Disaster Preparedness Center (ADPC, Bangkok) and funded by USAID/OFDA. The AUDMP aims to draw focus to reducing disaster risk of urban population, infrastructure, critical facilities, and shelter in selected Asian cities (visit [www.adpc.net](http://www.adpc.net) for further details). IUDMP was implemented by the Center for Earthquake Engineering Studies and the Center for Urban and Regional Development Studies at the Institut Teknologi Bandung (ITB). The objective of the project was to establish sustainable public and private sector mechanisms for



School building undergoing structural reinforcement

disaster mitigation. The city of Bandung was selected for a demonstration project, which would focus on implementing stricter building codes, and creating safer school communities through preparation for the possible impact of an earthquake. In

addition, the catastrophic earthquake that hit the city of Bengkulu in 2000 was a window of opportunity for the project to carry out a school retrofitting initiative with the blessings of the local authority.

### Activities of IUDMP

(In collaboration with government and non-government organizations)

- Basic intensity zoning mapping and risk assessment
- Campaign on earthquake awareness and preparedness for school children
- Training for school teachers on earthquake preparedness programming for school children
- Dissemination of information on earthquake preparedness for school children and adults in the form of leaflets, simple manuals, and posters
- Design and implementation of earthquake resistant school building construction and retrofitting for post-earthquake reconstruction programs
- Training of engineers and local government officials on earthquake resistant school buildings
- Training of small contractors and craftsmen on construction of earthquake resistant buildings

### Defining Disaster Mitigation



Disaster mitigation can be defined as “Measures taken in advance to reduce the impact of a disaster. It includes structural measures such as safer building construction and non structural measures such as education, training and technology transfer.”

## Earthquake Preparedness and the Dissemination of Information in Schools



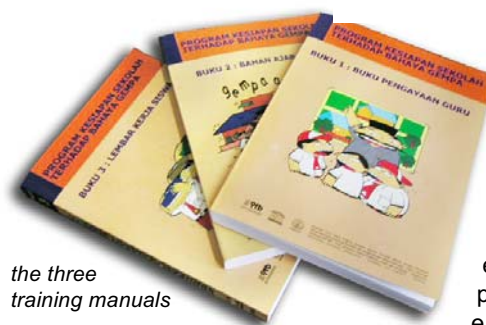
The project has a primary focus on school preparedness. The “Earthquake Education Training Program for School Teachers” through Training for Trainers (TOT), stands out amongst its activities.



Mrs. Harkunthi Rehayu

Mrs. Harkunthi Rehayu, the Coordinator of the Earthquake Preparedness and Safety program, shows great pride in how this project has evolved and what it has achieved. “In 1999, IUDMP developed the first training manual and implemented our first pilot teacher training project in 2001 to train 65 teachers on the risk of earthquake disasters. Due to its success the Ministry of Education wanted us to conduct a second training.”

One of the main outputs of the TOT training was the creation of three training modules: The Teacher’s Resource Book, The Teacher’s Manual, and The Student workbook. The Resource book aims to increase teachers’ knowledge on earthquake phenomena and preparedness. It contains valuable information on earthquake facts and findings, emergency responses, and earthquake preparedness. It is accompanied by a manual which provides hands-on instruction on how to teach earthquake preparedness activities. The Student’s Work Book is a fun and interactive way to get students involved and to increase their knowledge on earthquakes and preparedness.



the three training manuals

In order to evaluate whether the teachers had gained from the training, a simple test on several subjects relating to earthquake preparedness was executed. The test showed that the

majority of participants (85%) had successfully mastered the material. Evaluation of the effectivity of the training manuals was also done through questionnaires given to the participants. The results showed that the majority thought that all three manuals were helpful. Other responses from participants showed that some amendments to language and wording in the material were required.

The biggest problem however seemed not to be with the materials or training itself but with the ability to implement the training annually.



Illustrations of earthquake preparedness for children

Without appropriate funds and support, the TOT program is unable to take place and meet the demands of the Ministry of Education.



Dr. Krishna Prabadi, project manager of IUDMP

Dr. Krishna Prabadi, Project Manager of the IUDMP, acknowledges that there were several problems with the program. One of the biggest was making sure that teachers take the initiative to spread awareness in their communities. Dr. Krishna says, "Teachers have already been trained but there is no spill-over effect after that. Without teachers helping to spiral out what they've learnt, there is no dissemination of information outwards. It is the role of the Department of Education to oversee this continuation."

Education is unaware of the IUDMP initiatives. In an attempt to show interest in the new Head of Bandung's Department of Education, Dr. Edy Suwardi says, "I think this project is very important for us to create awareness on earthquake impact. But still we don't know much. It's very useful for us to know about this program." It is the local Education Department that has the most influence on schools and their curriculum within the city limits. Only with their greater involvement will earthquake preparation and awareness programs in schools reach sustainability.



Dr. Edy Suwardi, head of Bandung Department of Education

### Lessons Learned



More efforts must be made to ensure that the teacher trainings disseminate the knowledge outwards.

Mrs. Harkunti Rahayu adds, "In 2002, IUDMP implemented earthquake preparedness training in the areas of Bandung and Bengkulu, two high risk areas. This training was supported and funded by the Ministry of Education (MOE) and UNICEF. IUDMP also included some former trainees into the team for peer evaluation in order to update and revise manuals. After the year 2002, there was a demand for more training programs. The MOE wanted an annual training and for the year 2003 asked IUDMP to training as many as 330 participants from all over Indonesia. Unfortunately, due to a restriction in the budget IUDMP could accommodate only 90 participants that year." The main sponsor of funding was the MOE. UNESCO and UNICEF provided a one-time partial sponsorship.

### From Centralization to Decentralization

The government of Indonesia used to be a central authority that was in charge of allocating all budgets, funds, and approving all projects across Indonesia. The decentralization of the Indonesian Government means that administrative functions, resource allocation for development and authority is now distributed amongst local authorities.

While the IUDMP earthquake preparedness program has for the most part taken a top down approach in order to widely disseminate information on earthquake risk across Indonesia; decentralization ensures a bottom up approach. This will help tackle mitigation efforts unique to Bandung.

This process allows for a strengthened partnership between the earthquake preparedness program and local administration. This partnership is highly beneficial as it can procure the results needed to ensure that the program is a success.

### Lessons Learned



Long term commitment is required by stakeholders to ensure sponsorship for the continuation of training.

Partnerships between NGOs and local government will strengthen sustainability.

### Networking with NGOs

Developing a network of NGOs would strengthen the IUDMP program efforts, such as enhancing the awareness of mitigation measures to a wider audience. As NGOs are directly linked to donors as a funding source, it is necessary to convince donors of the importance of earthquake preparation in the cities of Indonesia.

In 1997, when the IUDMP commenced, the government of Indonesia had a centralized administration. Due to this centralization, it was thought that promoting the earthquake preparedness program from a centralized top down was an effective way to reach people. But in 1998 and 1999, the government began to decentralize, making the IUDMP top down strategy inappropriate.

Building the capacity of local governments and local departments involved in the mitigation process is essential under the current administrative set up. This requires convincing local government of the importance of earthquake mitigation activities. It also requires the building and strengthening of long lasting partnerships, trust, and continuous support. For instance, Bandung's Department of



Teachers undergo training on earthquake preparation at the UNCRD workshop in Bengkulu, September 2000



## Earthquake Safety Drills



One of the preparedness measures that came out of the teacher training was the implementation of Earthquake safety drills in classrooms.



### Why focus on schools?

- Children are vulnerable
- Schools are structurally weak
- The dissemination of information through children will ensure the awareness of future generations
- Schools can act as evacuation centers in case of disaster



**top:** Little girl at the ITB Earthquake Preparation Seminar follows an earthquake drill procedure

**middle:** Children at SD. Sabang hide under their desks in a demonstration earthquake drill

**bottom:** SD. Sabang school children role play how to deal with injured persons



Dhia Anjaini & Kevin Fbriansyah

In the crowded courtyard of SD. Sabang, an elementary school in the center of Bandung, children are enjoying their last day of school. In one classroom, enthusiastic students demonstrate what they have learnt through the school's earthquake safety program. When given the signal by their teacher, the students duck under their desks, simulating the shaking of the tables by moving them back and forth. When the shaking is over, at the command of the teacher and with great discipline, the children form a line and walk slowly out of the classroom and into the courtyard. Some students mimic injured persons and are helped out of the room by others. Role play of emergency response and first aid follows. The enthusiastic kids do not hesitate to make this simulation as authentic as possible. When they seem to be out of danger all the children line up and walk back to take their seats. They beam with pride.

Dhia Fitra Anjaini, a 10 year old school girl and her friend, Kevin Trikusumo Fbriansyah, an 11 year old boy speak about the earthquake safety program. The children, though shy, show that they are well aware of why earthquakes occur, "Earthquakes are disasters that occur when two tectonic plates meet each other." While drinking their juice bottles, they say that their teacher has taught them all about earthquakes in class and that they have read about them too. "We enjoy doing the earthquake drills. They are fun and we know that they are important because if an earthquake does happen, then we will be safe."



*"The local education office should be more aware of the training program and its importance."*

-Mr. Supono

Their teacher, Mr. Supono, was involved in the initial Training for trainers (TOT) program and has since assisted as a fellow trainer for other training sessions. He is pleased that the children enjoy the earthquake drills but he remarks that, "There are no people in the local department of education to integrate a curriculum on earthquakes. I had to do everything by myself." In reference to the TOT program he says, "The program is beneficial for preparing to face earthquakes. I hope that the program will continue, but there aren't that many schools that follow the TOT, just a few teachers from Bandung. I think to improve the program, we need more participants. The local education office should be more aware of the training program and its importance." Supono is doing the best he can to follow up on his training. He is one of the few teachers who has done this kind of follow up.



Children at SD. Sabang follow earthquake drill procedure. They file out of their classroom, protecting their heads with their school bag.

Three mothers of children in Mr. Supono's class talk about how pleased they are with this program. One mother, Wenny, says, "I think this program is very important because I have experienced earthquakes when I lived in Bengkulu. I did have some earthquake preparedness when I lived there, but we didn't understand it that much." She, as well as her two friends, Dian and Eneng, are glad that their children are learning and are enthusiastic about earthquake drills.

Poorer, more run down schools in Bandung appear less privileged in having such earthquake preparedness. In the winding alleys of a congested residential area on the outskirts of Bandung is SD. Tikukur. A building has already collapsed due to strong winds, and a new one is being erected. Children run and play on sand, mortar, and steel rods used for the building. The principal and teachers

have no real knowledge about the TOT program, but have been spectators to the IUDMP team running a small training seminar for a few classes in the school. The children have done an earthquake drill once under the training of the IUDMP, but this is not something that happens here anymore.

Mr. Teddy Boen, a pioneer on studying structural damage due to earthquakes complains about the difficulty in convincing people of the risk of earthquakes. "Earthquakes are the hardest hazard to convince people about, because you cannot

*"Only when people are convinced will effective mitigation happen...For the first time many teachers and contractors know the risk of earthquakes, and they know what to do- not to run out of the building, but to duck under a table or chair."*

-Mr. Teddy Boen

see it and it does not happen often. It is not like a flood or hurricane that occurs often and is visible. Only when people are convinced will effective mitigation happen." However, while Mr. Boen admits frustrations, he also admits to successes. He says, "For the first time many teachers and contractors know the risk of earthquakes, and they know what to do- not to run out of the building, but to duck under a table or chair."



Earthquake impact in a school building in Liwa, February 1994



## Information Products of IUDMP

In 1999, with additional funding from UNESCO, the IUDMP was able to create earthquake safety pamphlets and picture dictionaries for children. The material is colorfully cartoon illustrated and eye catching, simply explaining what children should do in the case of an earthquake. The pamphlets are available in English and Bahasa Indonesia. A thousand books and pamphlets were made and distributed to schools, followed by a teacher and student seminar held at Institute of Technology Bandung (ITB).



Earthquake picture dictionary and various pamphlets

The project also established an annual earthquake safety day. The first earthquake safety day seminar included teacher



Children make presentation at the ITB seminar

representatives from 26 schools in the Bandung district and 100 student participants from two schools, SD. Sabang and SD. Tikutpur. The seminar allowed teachers to understand the importance of earthquake preparation programs in the school curriculum, and students got to understand the effect of earthquakes on weak buildings and how this affects their own livelihoods. Exercises and simulations were used to demonstrate and visualize earthquake effects, including shake tables and the interactive use of posters, colors, art, and presentations in order for children to learn.

These initial activities were done to encourage students and teachers to effectively implement earthquake preparation in their schools.



## Making School Buildings Safer Structurally



Teddy Boen

In Bengkulu, an earthquake that occurred in 2000 damaged many school buildings as well as other critical facilities. Fortunately, it occurred in nighttime and there were no casualties. IUDMP was offered a window of opportunity through this event. In the aftermath of the disaster, the local government was receptive to the IUDMP message of making schools safer. While Bandung was the demonstration project for earthquake mitigation, Bengkulu became the replication project. The

project in Bengkulu offered technical guidance to retrofit school buildings in a cost-effective manner. Retrofitting is the process which reinforces existing buildings by structural modifications to provide greater strength to resist disaster impact. IUDMP requested Mr. Teddy Boen, a well known advocate of earthquake safety in Indonesia, to provide his experiences on how to carry out retrofitting in order to create a practical guideline. He draws from a wealth of knowledge accumulated in studying earthquake damage in Indonesia over several years. School buildings in Indonesia under the central government used a general design and hence the observation and analysis of structural weaknesses was made easier.



Observations of structural damage leads to the analysis of why they occurred through computer modeling. The process revealed the structural deficiencies in the generic design of Indonesian school buildings. The more common faults appeared to be

- Sliding of roof tiles
- Gable walls collapse
- Poor quality of materials
- Poor workmanship
- Poor masonry
- Poor anchoring of building components

IUDMP recommended the correction of weaknesses while leaving the buildings undemolished.

Where the buildings were damaged, they were



Training of masons and carpenters, Bengkulu, November 2000

repaired according to guidelines given. This was a big cost-saving initiative compared to the accepted practice of demolishing damaged buildings and constructing anew. Detailed construction drawings were made available so that contractors and masons were able to carry out acceptable building construction and retrofitting.

IUDMP also carried out training for contractors and masons to facilitate proper workmanship in retrofitting and new construction.

Teddy Boen explains that the greater aim of retrofitting is to prevent a building from collapsing. He also emphasizes that the process IUDMP has brought out is for Indonesia only. One can learn from the process but it may not be applicable wholesale elsewhere.

#### The process that led to Retrofitting of schools

1. Observing the damage done to school buildings over the years
2. Analysis of structural weaknesses observed and computer modeling of the building structure
3. Creating construction drawings for retrofitting based on the analysis
4. The Actual Retrofitting process: Correcting weaknesses in the building without dismantling the whole building (This ensures cost affectivity)

## Challenges

Dr. Krishna Pribadi contemplates some of the problems that the project has faced over the years. One of those difficulties has been convincing people in influential positions of the risk of earthquakes. This has directly affected the ability to gain appropriate funding. He commented that "There is general resistance in the country to these kinds of programs because they think that earthquakes are inevitable occurrences so we

*"We need to create this awareness through stakeholders. We have to convince local governments of the need to continue this project so that a budget can be made."*

-Dr. Krishna Pribadi

cannot do anything about it. But actually we can try to minimize the risk by improving the safety of school buildings. We need to create this awareness through stakeholders. We have to convince local governments of the need to continue this project so that a budget can be made."

The IUMDP Earthquake Preparation Program endeavoured to implement demonstration projects and to achieve success, but a lot more has yet to be done. The greatest challenge is replicating the work in other municipalities. By making the appropriate partnerships and with great commitment, the preparedness program can go a long way in creating safer school communities.



#### Lessons Learned



Need to assure the continuity of training for earthquake preparedness by convincing stakeholders of its benefits

left picture: A discussion group at the training workshop in Bengkulu, 2000



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### IUDMP

The Indonesian Urban Disaster Mitigation Project was launched in 1997 under the Asian Urban Disaster Mitigation Program (AUDMP) and coordinated by the Asian Disaster Preparedness Center (ADPC). The project aimed to draw focus to reducing earthquake vulnerability of the urban population, infrastructure, critical facilities, and shelter in all Indonesian cities and to establish sustainable public and private sector mechanisms for disaster mitigation.

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### Safer Cities

***Safer Cities** is a series of case studies that illustrate how people, communities, cities, governments and businesses have been able to make cities safer before disasters strike. The series presents strategies and approaches to urban disaster mitigation derived from analyses of real-life experiences, good practices and lessons learned in Asia and the Pacific. This user-friendly resource is designed to provide decision-makers, planners, city and community leaders and trainers with an array of proven ideas, tools, policy options and strategies for urban disaster mitigation. The key principles emphasized throughout Safer Cities are broad-based participation, partnerships, sustainability and replication of success stories.*

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### AUDMP

*The Asian Urban Disaster Mitigation Program (AUDMP) is the first and largest regional program implemented by ADPC. The AUDMP started in 1995 with core funding from USAID's Office of Foreign Disaster Assistance (OFDA) until 2003. The program was developed with the recognition of increased disaster vulnerability of urban populations, infrastructure, critical facilities and shelter in Asian cities. In an environment where good governance and decentralization are high in most countries' political agenda, AUDMP aims to demonstrate the importance of and strategic approaches to urban disaster mitigation as part of the urban development planning process in targeted cities of Asia.*



*AUDMP supports this demonstration by building the capacity of local authorities, national governments, NGOs, businesses and others responsible for establishing public and private sector mechanisms for urban disaster mitigation as part of city management. AUDMP also facilitates knowledge sharing and dialogue between key stakeholders to promote replication of AUDMP approaches to other cities and countries worldwide. Currently, the AUDMP approaches have been introduced and sustained by national partner institutions in targeted cities of Bangladesh, Cambodia, India, Indonesia, Lao PDR, Nepal, Philippines, Sri Lanka, Thailand and Vietnam.*

### ADPC

*The Asian Disaster Preparedness Center (ADPC) is a regional resource center dedicated to safer communities and sustainable development through disaster risk reduction in Asia and the Pacific. Established in 1986 in Bangkok, Thailand, ADPC is recognized as an important focal point for promoting disaster awareness and developing capabilities to foster institutionalized disaster management and mitigation policies.*

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