International Collaborative Education on Geoengineering for Disaster-Resilient Countries

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ABSTRACT: Against a backdrop in which the frequency of catastrophic natural disasters has been drastically increasing in Asian countries, Kyoto University has since 2011 organized a consortium with ASEAN Alliance Universities (ASEALUs) to offer a collaborative education project with the aim of establishing a new education program that focuses on disaster risk mitigation, recovery and restoration from catastrophic natural disasters. The project seeks to develop an education program that focuses on disaster risk mitigation/recovery/reconstruction between ASEALUs and Kyoto University, and the exchange of graduate students for the program between ASEALUs and Kyoto University as well as the exchange of experiences gained through working in disaster recovery/reconstruction. This paper presents a summary of project activities to enable an understanding of the project from the point of view of those engaged in geoengineering in ASEAN countries.

Keywords: disaster prevention, education, internationalization

1. INTRODUCTION

The frequency of catastrophic natural disasters has been drastically increasing in Asian countries, including Japan, since the late 20th century. This increase has made it clear that the establishment of a new paradigm to counter natural disasters, rather than the traditional concept of "disaster prevention," is an urgent task. Against this backdrop, the Kyoto University group proposed the construction of "disaster-resilient countries" by focusing on disaster risk mitigation, recovery and restoration from disasters, and the development of a related education program. In order to fulfill the above plan, Kyoto University was selected as one of the universities to participate in the Re-Inventing Japan Universities Project, which is five-year project subsidized by the Japanese Ministry of Education, Culture, Sport, Science and Technology (MEXT); and, to this end, established in December 2011 a collaborative education consortium comprising the six universities in five Asian countries shown in Figure 1.

The project on disaster-resilient countries (DRC) seeks to develop an education program that focuses on disaster risk mitigation, recovery and reconstruction between ASEAN Alliance Universities (ASEALUs) and Kyoto University, and the exchange of graduate students for the program between ASEALUs and Kyoto University as well as the exchange of experiences gained through working in disaster recovery/reconstruction. After fruitful discussions by committee members of the consortium, a pilot DRC education program was conducted in Thailand and Japan in 2012 with the participation of students from three universities in Thailand.

However, the implementation of the program was not easy. The DRC education program covers not only engineering knowledge but also interdisciplinary knowledge such as medical, environmental and economic knowledge for participating students, who have diverse backgrounds. This was a really ambitious attempt. As a result of the implementation of the pilot program, it was found that some revisions were necessary to fulfill the mission of the project. Thus the consortium held a Faculty-Development Symposium in March 2013 to shed light on the program's problems. Based on the results of discussions, the 2013 program was revised to help DRC students understand the key concepts of the project. Reflecting the revision of the education program, the second version of the DRC education program started this year, with the participation of students from two more universities: Vietnam National University, Hanoi, and the Institute of Technology, Bandung.

From the viewpoint of the recent frequent disasters and people's awareness, the DRC education program is truly timely. Therefore, in this paper, a brief summary of the project activities is presented to gain an understanding of the faculty members/engineers who engage in geoengineering in ASEAN countries, focusing on the activities of the student exchange program.

2. STRUCTURE OF DRC EDUCATION PROGRAM

2.1. Curriculum of DRC education program

In order to cover not only engineering knowledge but also interdisciplinary knowledge such as medical, environmental and economic knowledge for participating students who have diverse backgrounds, the DRC education program comprises three subjects: Basic

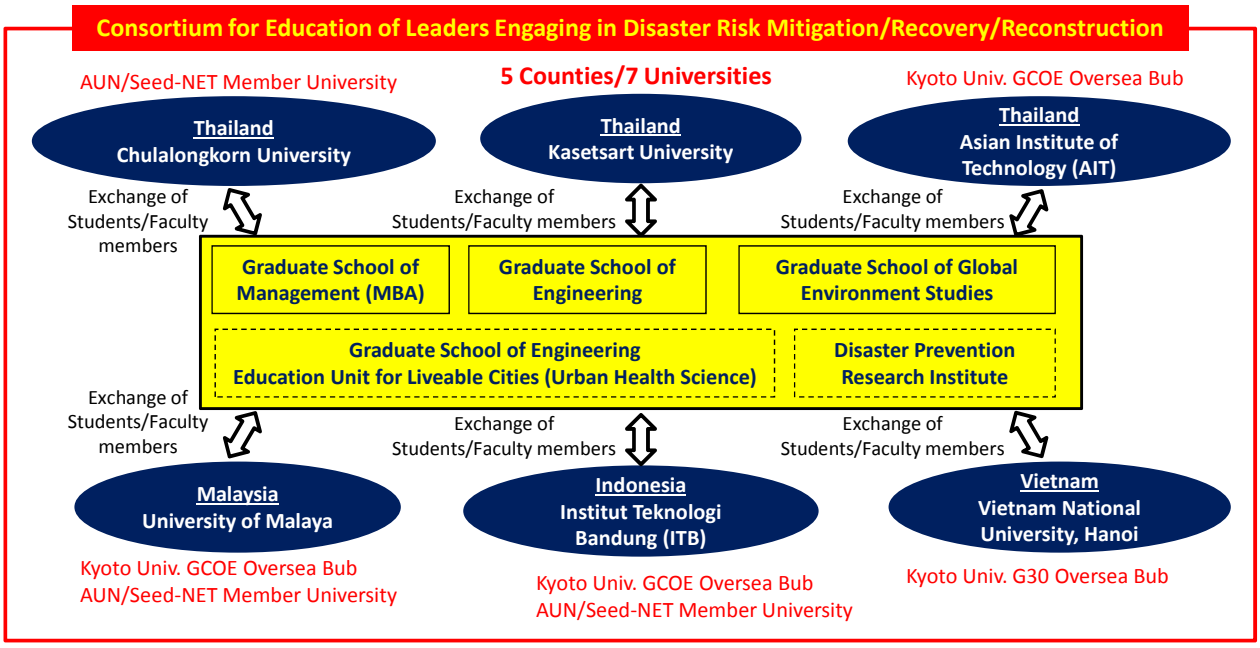

Figure 1: Structure of Consortium

Table 1: Contents of Engineering Subjects and Management Subjects for DRC Education Program

Classification		Title	Place	Type
Engineering Subjects	ES-1	Environmental issues for disaster recovery	Kyoto Univ.	Intensive lecture
	AES-1	Engineering Seminar for Disaster Resilience in ASEAN countries 1	ASEAN Alliance Univ.	Intensive lecture
	AES-2	Engineering Seminar for Disaster Resilience in ASEAN countries 2	ASEAN Alliance Univ.	Intensive lecture
Management Subjects	MS-1	Disaster and Health Risk Management for Liveable City	Kyoto Univ.	Intensive lecture
	MS-2	Disaster Prevention & Recovery Management	Kyoto Univ.	Distance learning
	MS-3	Policy Evaluation	Kyoto Univ.	Distance learning

Subjects, Engineering Subjects, and Management Subjects. Of these three subjects, Basic Subjects, which covers a fundamental knowledge of disaster risk, correspond to the subjects offered at each Alliance University in English so that the establishment of new subjects or the exchange of students is not required. Engineering Subjects, which bridges the gap between Basic Subjects and Management Subjects, offers practical knowledge by looking at disasters that have actually occurred. Management Subjects offers interdisciplinary knowledge, which is required for management candidates who will engage in recovery and restoration from disasters.

During the discussion on the establishment of the education program, committee members faced serious problems in that the different timings of term breaks at member universities makes student exchange among universities difficult. In fact, each university uses a different semester system so that it is impossible to select the existing subjects offered at each university. After discussions by committee members of the consortium, it was agreed that in order to cope with the above difficulties, three engineering subjects and three management subjects, as shown in Table 1, be established that would be offered by intensive lectures and distance learning.

In Engineering Subjects, ES-1 mainly covers topics associated with the treatment of tsunami debris such as separation, recycling and reuse for construction material from the viewpoints of geoenvironmental engineering. AES-1 and AES-2 mainly cover topics associated with natural/man-made disasters occurring in ASEAN countries. As for Management Subjects, MS-1 offers new topics, which feature community-based disaster prevention measures and medical knowledge such as mental health and brain function after a disaster in addition to engineering knowledge. Both MS-2 and MS-3 offer topics associated with business-based knowledge focusing on the

Contents	2013					2014	
	Aug	Sep	Oct	Nov	Dec	Jan	Feb
1. Japan							
a) ES-1	16 ⟷ 26						
c) MS-1	5 ⟷ 14						
e) MS-3			Distance learning from Kyoto Univ. (Tue,1100-1230(GMT+7)) ⟷				
2. Thailand							
AES-1 & AES-2		5 ⟷ 27					

Figure 2: Schedule of 2013 DRC program

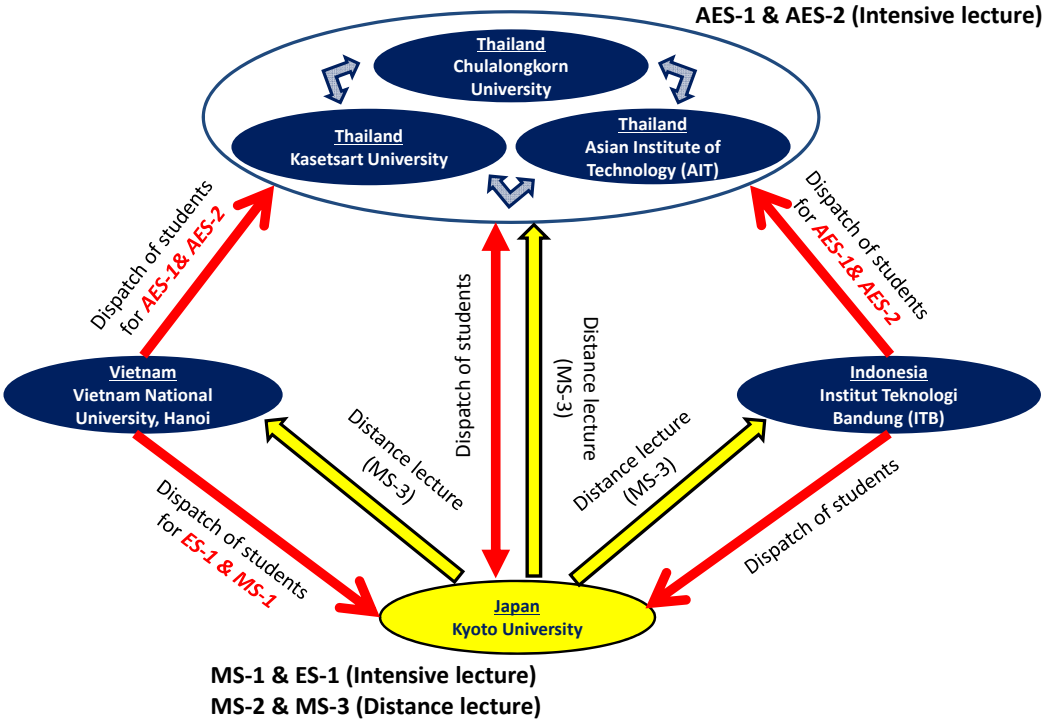

Figure 3. DRC Collaboration Plan in 2013

cost benefit of investment for disaster preparedness, a business continuity plan (BCP), and so on from the socioeconomic viewpoint. In this manner, the subjects newly established for the DRC education program offer interdisciplinary knowledge.

Of the six new subjects, ES-1 and MS-1, which are intensive lectures offered at Kyoto University, consist of intensive lectures and a field trip to areas affected by natural disasters in Japan. AES-1 and AES-2, which are intensive lectures offered at an ASALU, also comprise intensive lectures and a field trip to areas affected by natural disasters in an ASEAN country. MS-2 and MS-3 are offered from Kyoto University to ASEALUs by distance learning for one semester.

2.2. Implementation of DRC education program

The number of students who participate in the program is 15 graduate students from ASEALUs, and 15 from Kyoto University. In the case of the second program in 2013, three graduate students selected from each ASALU, with the exception of the University of Malaya, Malaysia, took part in the DRC education program.

Reflecting the problems associated with different term breaks, the actual schedule of the 2013 DRC program was determined as shown in Figure 2. The first segment of the

Table 2: The Schedule of ASEAN Engineering Subject, AES-1, 2013

Date	No.	Content	Lecturer
Sep.5	1	Geo-Risk Engineering	Prof. Ohtsu (Kyoto Univ.)
	2	Geo-Risk Engineering	
	3	Exercise (PC Operation)	
Sep.6	4	Earthquake Disaster (1)	Dr. Pennung (AIT)
	5	Earthquake Disaster (1)	
	6	Exercise	
Sep.9	7	Earthquake Disaster (2)	Prof. Iswandi (ITB)
	8	Earthquake Disaster (2)	Dr. Krishna (ITB)
	9	Exercise	
Sep.10	10	Tsunami Disaster	Dr. Anat (Chulalongkorn Univ.)
	11	Tsunami Disaster	
	12	Exercise	
Sep.11	13	Landslide Disaster	Dr. Suttisak (Kasetsart Univ.)
	14	Landslide Disaster	
	15	Visit landslide research unit, Kasetsart Univ.	
Sep.14	**16**	**Final Exam.**	

program in Japan offered MS-1 and ES-1, and the second segment of the program offered by Kasetsart University, Thailand, offered AES-1 and AES-2. That is to say that in August, 15 graduate students from ASEALUs stayed in Kyoto and attended intensive lectures on MS-1 and ES-1 together with 15 students from Kyoto University, constituting one class of 30 students. In the same manner, in September, students from ITB, VNU and Kyoto University stayed in Bangkok and attended intensive lectures on AES-1 and AES-2 together with nine students from three universities in Thailand again. As the third segment of the program in 2013, the lecture on MS-3, participated in by distance learning, started on October 1, 2013 and is ongoing. The procedure of the 2013 DRC education program, including multiple exchanges of students explained above, is summarized in Figure 3.

As for the implementation of the DRC education program, lectures on subjects offered at Kyoto University—ES-1, MS-1, MS-2 and MS-3—are conducted by Kyoto University faculty members. Lectures for AES-1 and AES-2 in 2013 are shared by faculty members that take part in the student exchange program collaboratively, as shown in Table 2 and Table 3. This is a feature of AES-1 and AES-2, in which contemporary topics associated with natural/man-made disasters that have actually occurred and how disasters are handled in different countries are presented. In order to investigate the best approach to disaster risk mitigation, and recover/restoration, it is necessary to study the social system of each country.

AES-1 and AES-2 were offered at Kasetsart University in both 2012 and 2013, with the participation of 30 students from ASEALUs and Kyoto University. For 2014, it has been decided after discussion with committee members of the consortium that ITB be the responsible university for AES-1 and AES-2. Therefore, AES-1 and AES-2 are scheduled to offer topics associated with natural disasters that have actually occurred in Indonesia for students who participate in the DRC program. It is expected that volcano disaster will be added to the contents of Engineering Subjects.

3. CONTRIBUTION OF GEOENGINEERING TO DRC EDUCATION PROGRAM

This section describes how geoengineering contributes to the DRC education program. As explained previously, the contents of ES-1 is closely related to geoengineering because it deals with the treatment of tsunami debris for reuse as construction materials. The contents of AES-1 and AES-2, shown in Table 2 and Table 3, also have a close relation with geoengineering. However, given a situation in which the frequency of hazard-level events such as heavy rainfalls, massive earthquakes and tsunami is

Table 3: The Schedule of ASEAN Engineering Subject, AES-2, 2013

Date	No.	Content	Lecturer
Sep.16	1	Flooding Disaster (1)	Dr. Sucharit (Chulalongkorn Univ.)
	2	Flooding Disaster (1)	
	3	Visit BMA Flood Control Center	
Sep.17	4	Flooding Disaster (2)	Prof. Nhuan (VNU)
	5	Flooding Disaster (2)	
	6	Exercise	
Sep.18	7	Costal/River Erosion	Dr. Anurak (Chulalongkorn Univ.)
	8	Costal/River Erosion	
	9	Exercise	
Sep.19	10	Land Subsidence	Dr. Noppadol (AIT)
	11	Land Subsidence	
	12	Exercise	
Sep.20	13	Water Resource Engineering	Dr. Tachikawa (Kyoto Univ.)
	14	Water Resource Engineering	
	15	Exercise	
Sep.23	**16**	**Final Exam.**	

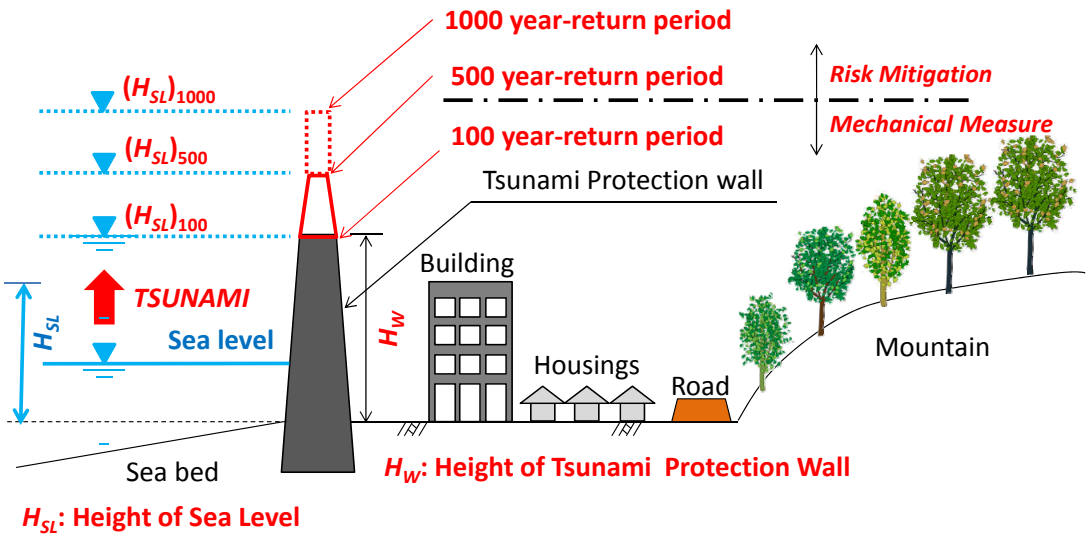

Figure 4: Concept of Design for Tsunami Protection Wall

increasing drastically, geotechnical engineers need to understand the limitations of conventional mechanical measures and try to envisage comprehensive measures to counter disasters. Catastrophic events such as the 2011 Tohoku Earthquake has made us realize that the traditional concept of "disaster prevention" is not enough to save societies, communities and human lives. For instance, as shown in Figure 4, in the case of the design of a tsunami protection wall, it is not feasible to design a high enough wall as a mechanical measure, considering the hazard level, which exceeds a 100-year return period. In such a case, the best plan is to establish an early warning system for evacuation and/or relocate residential areas behind a tsunami protection wall to hillside locations to mitigate disaster risk and realize swift recovery from disaster.

Of the above-mentioned disasters, land subsidence is the only man-made disaster—the others are natural disasters.

The disorderly expansion of megacities toward the outskirts of suburban areas requires the use of more water, meaning that groundwater is being extracted to excess. Consequently, land subsidence resulting from this excessive groundwater extraction causes various forms of damage such as damage to housings/buildings, damage to the foundations of infrastructures, an increase of flood risk, the intrusion of salt water into aquifers, and coastal erosion. In addition to land subsidence, disorderly development in mountainous areas causes deforestation so that the risk of landslides and flooding increases. In other words, disorderly development, which is absolutely regarded as a man-made hazard, can trigger natural hazards. Therefore, without comprehensive measures, traditional concepts that heavily rely on mechanical measures are useless.

From such a viewpoint, it can be seen that the DRC education program is a timely one with respect to making those who engage in geoengineering, and who are familiar with the traditional approach, understand the importance of the construction of disaster-resilient countries, which requires interdisciplinary knowledge and handle problems related to disasters comprehensively.

4. CONCLUSION

Recently, the internationalization of universities has been a key issue all over the world. The promotion of the exchange of students among universities, which is feature of the DRC project, is absolutely one of the main issues with respect to the internationalization of universities. The first step toward internationalization is to enhance mutual understanding among people. Therefore, the author hopes that students participating in the DRC product obtain fruitful products through lectures and discussions, and create human networks.

To conclude the paper, the author would like to express sincere appreciation for the great efforts made by those who have been engaged in the preparation, implementation and organization of the DRC project.