Scientific Capacity Building for Climate Impact and Vulnerability Assessments (SCBCIA)

FINAL REPORT

Capacity Development for Adaptation to Climate Change in the Rural Coastal Zone of Vietnam (CIA2009-06-Duc)

APN
Asia-Pacific Network for Global Change Research
CAPaBLE

Making a Difference

Scientific Capacity Building & Enhancement for Sustainable Development in Developing Countries

MM GeoPro

Monitoring & Modeling of Geotechnical Processes

Project Reference Number: CIA2009-06-Duc
Final Report submitted to APN

PROJECT LEADER
Assoc. Prof. Dr. Do Minh Duc
Hanoi University of Science
Email: ducdm@vnu.edu.vn

PROJECT COLLABORATORS

Prof. Dr. Nobuo Mimura
Email: mimura@mx.ibaraki.ac.jp

Prof. Dr. Kazuya Yasuhara
Email: yasuhara@mx.ibaraki.ac.jp

Ibaraki University, Japan

MSc. Duong Thi Toan
E-mail: duongtoan109@gmail.com

Dr. Nguyen Thi Minh Thuyet
E-mail: nguyen.thuyet@gmail.com

Mr. Dang Quang Khang
E-mail: khangdq@gmail.com

MSc. Dang Van Luyen
E-mail: luyendv@vnu.edu.vn

Hanoi University of Science, Vietnam

Assoc. Prof. Dr. Sc. Vu Cao Minh
E-mail: vucaominh@gmail.com

Institute of Geology, Vietnam Academy of Science and Technology

PAGE LEFT INTENTIONALLY BLANK

OVERVIEW OF PROJECT WORK AND OUTCOMES

Non-technical summary

Climate change (CC) is the most serious environmental problem facing the world today. It puts more pressure on all socio-economic activities. In term of climate change-related losses it can easily recognize a much larger potential damages in urban to rural areas. Therefore lots of efforts have focused in urban areas, especially coastal mega-cities. The rural areas are not properly considered in some cases. This research investigates the potential vulnerability of rural coastal zone in Vietnam. Activities are concentrated on capacity building for local people and concerning young scientists. Several workshops were organized for those people. Residents in rural coastal areas are more vulnerable to climate change because of lower awareness and poor infrastructure. Impacts of CC make sense for a lot of them. Local authority at district level did join meetings, training courses on CC and their awareness is much better, but they keep wondering about a wise adaptation which needs a total solution from higher level. To do so a sound emergence of science should taken into account. Two workshops with the participation of experts from Japan, Germany, and concerning institutions were organized to share experiences on wise adaptation to CC. It was planned to give a more comprehensive understanding about CC in scientists and contribute to enhance the quality of CC research in the coastal zone of Vietnam.

Objectives

The main objectives of the project were:

1. To help the local authority and residents to know about risks of climate change and gain initiative in adaptation to climate change.
2. Review the effectiveness of the available coastal engineering measures and help to propose the suitable measures for a wise adaptation to climate change in rural coastal areas.
3. Contribution to climate change graduate education in Hanoi University of Science.

Amount received and number years supported

The Grant awarded to this project was:
US$ 28,500 for 1 Year 2009/2010:

Activity undertaken

- One day workshop for local authority at district and commune levels was organized in Hai Dong commune, Hai Hau district, Nam Dinh province. 49 people attended the event.
- Two workshops for sharing experiences and training young scientists were implemented with the participation of 2 professors from Japan, 1 professor from Germany, and 15 experts from concerning institutions in Vietnam. These issues attracted more than 43 young scientists.
- Two days field trip to Hai Hau was carried out. Professors from Japan, HUS together with 4 young scientists were joining the survey.
- Submit and publish papers for international and national journals. Writing syllabuses for master programmes on “Climate Change Adaptation” and “Geoenvironment and Geohazards” in HUS.

Results

1] Two scientific papers in peer reviewed national and international journals;

2] 43 young scientists are trained through the activities of the project; enhancement the awareness and knowledge on climate change-related vulnerability and risk for 49 people of local authority (commune and district levels);

3] The project sets fundamentals for a proposal on "Capacity development and technology transfer for monitoring of seadike system in the Red River delta, Vietnam" submitted to the Monbu-kagaku-shou fund of Japan (the proposal is in Japanese written by Prof. Kazuya Yasuhara (Ibaraki University) and will not be attached in the report). The project also helps one PhD student to do the research on seadike stability on the context of climate change;

4] Contribution to the scientific database of Hai Hau coast including information and research results of climate change-related risks in different scenarios of sea level rise; recommendations for coastal protection in Hai Hau;

5] Scientific procedure for vulnerability risk assessment in rural coastal zone of Vietnam in the context of climate change.

6] PowerPoint lectures and concerning data for teaching on climate change adaptation in Hanoi University of Science. This result contributes to ensure the achieved data and experience will be sustainably disseminated for young scientists in Vietnam.

Relevance to APN's Science and Policy Agenda

The rural coastal zone of Vietnam has high density population. Main economic sectors are agriculture and fishery which are high vulnerability to climate change. Moreover the area is still least developed and the awareness of the local residents on the issue of climate change is very poor. The focus of this project is therefore meets the requirements of APN and SCBCIA programme. The project also contributes to scientific capacity building for Vietnam young scientists and practitioners by working with Japanese scientists through learning-by-doing and training-by-doing. The awareness of local managers is also improved through the short courses. Therefore the project meets one of the main priorities of APN which is awareness of climate change among people and scientists.

The project implements 3 main activities, including scientific capacity building, pilot study and dissemination of the research. The short courses are organized for local managers (commune and district level) and technical practitioners on impacts of climate change to the coastal zone. The lecturers are experts of Vietnam and Japan. The courses focus on the potential risks of climate change to Asia-Pacific region, with an emphasize on the rural coastal zone of Vietnam. Then suitable engineering and non-engineering counter measures, experiences on community-based for natural disaster reduction were discussed depending socio-economic condition of developed and developing countries. A case study was implemented at the Hai Hau coast (Nam Dinh province) - one of the most severe erosion coasts in Vietnam. The research contributes to clarify the intensification of natural hazards related to climate change, review the capacity of available counter measures, propose suitable adaptation, and to avoid mal-adaptation. Two international workshops were carried out on the subject of "*Capacity Development for Adaptation to Climate Change in the Rural Coastal Zone of Vietnam*" and *"Mitigation of Hazard Risks in Response to Climate Change"*. In addition, concerning presentations and a syllabus of "Assessment of Climate Change Risks" can be used for lecturing of under-graduate subject on "Natural Disaster" and graduate programme on "Climate Change Adaptation" in Vietnam National University, Hanoi.

Self evaluation

All proposed activities were successfully implemented. Workshops have attracted many scientists and experts, especially young scientists as Ph.D, master, and undergraduate students of Hanoi

University of Science. A close contact to the people and local authority of Hai Hau district has been set up. The conversation and document transfer can help to improve awareness on the issue of climate change for coastal residents in the region. A series of workshops and presentations of Vietnam and foreign professors provide good references for a master programme on Climate Change in Vietnam national University, Hanoi. The published works are well prepared one paper was established and another is submitted to the peer international journal – Journal of Asian Earth Sciences.

Potential for further work

Referring from this project, we have seen that people and decision makers would like to care about "in sight" or short-term problems rather than something last for decade or century. They know global change puts more pressure on almost every activity but they do need to know and raise awareness about the short-term impacts. We highly call for more attention on this issue and also would like to continue the activities to contribute to solve the problem.

Publications

1. Do Minh Duc, 2010. Coastal Protection in the Context of Climate Change: A Case Study of Hai Hau Coast. Vietnam Geotechnical Journal (English Series).
2. Do Minh Duc, Mai Trong Nhuan, and Chu Van Ngoi, 2010. An Analysis of Coastal Erosion in the Tropical Rapid Accretion Delta of the Red River, Vietnam (submitted). Journal of Asian Earth Sciences.

References

Brunn, P., 1962. Sea-level rise as a cause of shore erosion. Journal of Waterways and Harbor Division, American Society of Civil Engineers, Vol. 88, 117-130.

Coleman, J. M., and Wright, L. D., 1975. Modern river deltas: Variability of process and sand bodies, in: Broussard, M. L. (ed.), Deltas, Models for Exploration, Houston Geological Society, Houston, TX, pp. 99-149.

Davis, R.A. and Hayes, M.O. (1984). "What is a Wave-Dominated Coast ?", Marine Geology, Vol. 60, p. 313-229.

Duc, D.M, Nhuan, M. T., Ngoi, C. V., Tran Nghi, Tien, D. M., van Weering, Tj. C. E., van den Bergh, G. D., 2007. Sediment distribution and transport at the nearshore zone of the Red River delta, Northern Vietnam. Journal of Asian Earth Sciences, Vol. 29, Issue 4, 588-565.

Do Minh Duc (2002). "The Reasons of Coastal Erosion in Hai Hau District, Nam Dinh Province", *Scientific Workshop No. 15 in Hanoi University of Geology-Mining.*

Do Minh Duc (2003). "The Model for the Sea Dike Stability Analysis". *The Science – Mining Technology Journal No. 3/2003.*

Gao, S. and Collins, M. (1992). Net Sediment Transport Patterns Inferred from Grain-size Trends, Based upon Definition of "Transport Vectors". *Sedimentary Geology, Vol. 80, 1992. p.47-60.*

Hoan, N., and Phai, V. V., 1995. Topographical change and the formation of sand bars in the Red River (Ba Lat) mouth. Vietnam National University, Hanoi's Project report, pp. 66 (in Vietnamese).

Hoekstra, P. and van Weering, Tj.C.E., 2007. Morphodynamics of the Red River delta, Vietnam: Introduction to the special issue. Journal of Asian Earth Sciences, Vol. 29, Issue 4, 505-507.

Kriebel, D. L., and Dean, R. G., 1993. Convolution method for time-dependent beach-profile response. Journal of Waterway, Port, Coastal and Ocean Engineering, American Society of Civil Engineers, Vol. 119, No. 2, 204-227.

Ministry of Natural Resources and Environment (MONRE) (2009). *Climate Change, Sea Level Rise Scenarios for Vietnam.*

Nhuan, M. T., Hai, T.Q., Ngoi, C.V., Manh, L.V., and Vi, P.V., 1996. Establishing Environmental Geological map of shallow sea (0-30 m deep) in Ngason – Haiphong area, scale 1: 500,000, pp. 94 (in Vietnamese).

Nguyen Ngoc Thuy (1995). *The South China Sea Tide and Sea Level Change in Vietnam Coastal Zone.* Research KT-03-03, National Program KT-03. 195pages.

Pham Thi Thuy Hanh and Masahide Furukawa, 2007. Impact of Sea Level Rise on Coastal Zone of Vietnam. *Bull. Fac. ScL, Univ. Ryukyus*, No.84 : 45 - 59 (2007).

Pruszak, Z., Szmytkiewicz, M., Hung, N. M., and Ninh, P. V., 2002. Coastal processes in the Red River delta area, Vietnam. Coastal Engineering Journal, Vol. 44, No.2, 97-126.

U.S. Army Corps of Engineers (2002). *Manual of Coastal Engineering.*

Van den Bergh, G.D., Boer, W., Schaapveld, M.A.S., Duc, D.M., and van Weering, Tj.C.E., 2007. Recent sedimentation and sediment accumulation rates of the Ba Lat prodelta (Red River, Vietnam). Journal of Asian Earth Sciences, Vol. 29, Issue 4, 545-557.

Vinh, T. T., et al. (1996). "Sea Dike Erosion and Coastal Retreat at Nam Ha Province, Vietnam". *Coastal Engineering 1996, Chapter 28, p. 2820-2828.*

Acknowledgments

We would like to express our sincerely thanks to the Asia-Pacific Network for Global Change Research (APN). The professional arrangement of APN gives a great help to our activities. The research was strongly supported by Hanoi University of Science and local authority of coastal provinces, districts, and communes, especially Nam Dinh province, Hai Hau district, and 7 coastal communes of Hai Hau district. We would like to thank very much for these supports. Two professors from Ibaraki University are also highly appreciated for their fervent participation in the whole process of the research. Finally, may thanks to concerning experts and institutions from Ministry of Agriculture and Rural Development, Ministry of Natural Resources and Environment, and other NGOs for their participation and encouragement for the project.

TECHNICAL REPORT

Preface

Climate change is seriously impacting on economies, societies and ecosystems all around the world, especially in the Asia-Pacific region. The strategies for mitigation and adaptation to the consequences caused by climate change are vital. Such strategies are determined by considering circumstances of respective sites, which include natural, social, and human environments. The coastal zone is mainly situated in the lowlands and is one of the most vulnerable areas to climate change. The area also has its own typical natural, social, and human environments. Moreover the low awareness of local people in the rural areas can lead to more vulnerability. A wise adaptation to climate change in coastal zone in general and rural areas in particularly should be first priority and utmost important.

Table of Contents

1.0 Introduction

Vietnam faces tremendous changes and challenges in the field of urban development. In addition to the expected pressures of rural-urban migration, urban growth and the economic impact of globalization, Vietnam cannot escape the impacts of climate change. A recent report by the World Bank has ranked Vietnam first in terms of climate change's impact on population, GDP, urban extent and wetland areas. Along with the natural effects, human activities in the last recent decades, with the introduction of the economic renovation have been using and changing the area with various newly-introduced livelihoods. These natural and anthropological forces have been placing the area difficulties in coping with the increasing impacts of climatic change.

The rural coastal zone in Vietnam is situated in the lowlands and is one of the most vulnerable areas to climate change. However the available researches focus mainly in the cities, the impacts of climate change to the rural coastal zone in its typical natural and socio-economic situation are not well clarified. The so-called 4 in-situ guidelines for disaster reduction is commonly used in Vietnam therefore the local authority plays very important role. More or less the experiences of these people referring from last events can affect the activity in a future event. It is hard for them to recognize and adapt well to the long-term impacts of climate change and tendency of intensification of natural hazards.

Vietnam has long coastline with different natural and socio-economic condition. To understand the mechanism of climate change impacts a research at detail scale should be implemented. Therefore a pilot study at district and commune levels of Hai Hau coast is selected. This tends to support for climate change adaptation based on the community. Hai Hau is a district in costal zone of Nam Dinh province (North Vietnam) that has been formed by deposition process of the Red River delta system. The population density of 1,400 persons/km^2. The shoreline is a straight line directing from Northern East to Southern West in a distance of about 27 km. The Hai Hau coast includes 7 communes such as Hai Loc, Hai Dong, Hai Ly, Hai Chinh, Hai Trieu, Hai Hoa, and Hai Thinh. The area has been well-

known as the most severe erosional coastal zone in the North of Viet Nam. The erosion rate reaches 15-20m/year. It has a clear tendency of increasing caused by sea level rise. Herein, the erosion has caused great damages on the local infrastructure and even loss of lives that leads to significant disadvantages for social-economic development in the region.

The project aims to help the local authority to know the new risks of climate change and gain initiative in adaptation to climate change. One of the main issues relating to climate change is coastal protection. The joint research group between Japan and Vietnam can review the effectiveness of the available coastal engineering measures and help to propose the suitable measures that take consideration of climate change in coastal protection. Results of pilot study can be good references for lecturing of climate change, a quite new subject in Vietnam's universities.

2.0 Methodology

The methodology includes working packages (WP) and activities which are subsequently implemented.

WP1: Data collection and review

1.1 Review of documents related to climate changes (policies papers, forecast scenarios, etc.); the project is will collect and synthesize the available data on climate change and its impacts to the coastal zone of Vietnam;

1.2 Review of climate change vulnerability and risk in rural coastal areas;

1.3 Review of scenarios & National Target Program indications for rural coastal areas;

1.4 Review of current mitigation and/or adaptation measures against risk of climate change in Vietnam.

WP2: Evaluation of existing approaches for vulnerability assessment in Vietnam (a case study of Hai Hau coast)

2.1 Review of current methodology with emphasize on IPCC methodology;

2.2 Extensive fieldwork in the pilot study - Hai Hau coast. The fieldwork is co-implemented by Vietnam scientists and Japanese collaborators to assess the actual situation of coastal protection in one of the most vulnerable coast of Vietnam.

2.3 Supplementary field measurement and laboratory testing to define current topography, sediment, flow characteristics, seadike system in Hai Hau coast;

2.4 Modeling the changes of the coast in different scenarios of sea level rise (according to the estimation of Ministry of Natural Resources and Environment, 2009).

2.5 Vulnerability assessment of Hai Hau coast. The critical comments on IPCC methodology for a typical condition of Vietnam rural area can be referred;

2.6 Recommendation of adaptation measures for coastal protection.

WP3: Capacity building

3.1 Course on "Coastal Engineering and Vulnerability Assessment" for experts and practitioners will be organized to share and disseminate experiences of high-ranking Japanese and Vietnamese experts to the participants. The concerning issues of Hai Hau are highlighted as an example of climate change adaptation in the typical natural and socio-economic condition of Vietnam.

3.2 Short course on "Reduction of Risks due to Climate Change in the Coastal Zone" for local managers. The invited participants are managers at commune and district levels as well as some local residents in the pilot study area;

3.3 Vietnam young scientists can enhance their expertise by working with Japanese scientists on the fieldwork and data processing.

WP4: Dissemination

4.1 Two papers for peer-reviewed international and national scientific journals;

4.2 Two workshops on climate change and hazard risks were held in Hanoi;

4.3 Syllabus of lectures for undergraduate and graduate students on the subject "Natural Disaster" and "Assessment of Climate Change Risks".

3.0 Results & Discussion

3.1. Scientific workshops

Two workshops were organized under the support of the project. Main objectives of the workshop are to exchange experience between professors and experts from Vietnam, Japan, and Germany; then to contribute to capacity building for young scientists in the field of coastal engineering and climate change adaptation.

The first workshop was held in Hanoi on 28 July 2010 with the title of *"Capacity Development for Adaptation to Climate Change in the Rural Coastal Zone of Vietnam"*. It attracted the participation of Resource more than 50 people. They mainly came from several faculties of Earth Science in HUS such as Geology, Geography, Environmental Sciences, and Meteorology – Hydrogeology – Oceanography, and concerning institutions, including Vietnam Geotechnical Institute, Institute of Geology and Geography, Hanoi Water Resource Trace Institute, Institute of Science on Geology and Mineral, Hanoi University of Geology and Mining, Hanoi University of Water Resources, and Ministry of Agriculture and Rural Development.

During the workshop several issues were discussed, especially on exchanges research experience on the current problems that focused on sea dyke system erosion and its solutions. Two Japanese professors presented the overview the problem in the Asia Pacific caused by global climate change, the problems relative to typhoon, inundation, global mean sea level rise and all these impaction to increasing geo-hazard in coastal zone area. The technical solutions also were given for sea dike erosion with some case study in Japanese coastal zone. Prof. N. Mimura gave a presentation on "Challenges of Climate Change for Asia Pacific and Adaptation Solution". It reviews the trend and evidences of climate change. Scenarios of climate change according to AR4 of IPCC were then presented. In the context that climate change still makes sense for many "old" earth scientists, it can contribute to prove the fact and change their attention and attitudes. The information is also very useful for participants, especially young scientists, students, and staffs from concerning institutions. The presentation provides experiences on adaptation to climate change rural areas with an example of Bangladesh and urban areas with examples of Male's island and Tokyo bay (Japan). Adaptive measures cover both cases of developing and developed countries that helps to get a broad view of the situation. However adaptive measures are location dependent issue so only ideas and technology can be transferred from country to country but the implementation should be taken into account depending on local natural and socio-economic situation. Prof. Yasuhara gave a presentation on "Adaptation Technology to Natural Hazards Induced by Climate Change". It

introduces risks of coastal zones due to sea level rise, typhoon, storm surge, torrential rainfall, liquefaction, and economic loss of these hazards. It reviews the impacts of sea level rise and climate change in several cases of Tokyo (Japan), New Orleans (USA), Bangkok (Thailand), and Venice (Italy). The adaptive measures include protection, accommodation, and evacuation (retreat) that can be differently used for each hazard (Table 1). Then some discussion is focused on an "ideal adaptation" of geo-engineering that creates a system with cost-saving, disaster reduction, and mitigation of environmental impacts.

Table 1. Adaptation to coastal natural hazards

Hazard	Adaptation		
	Protection	Accommodation	Evacuation
River flood	Additional banking Water protection work Early warning system and evacuation system Construction of shelter	Hazard map Appropriate land use Regulation of land use in hazardous area Insurance	Restriction of development Evacuation from dangerous area Public support for evacuation
Liquefaction	Monitoring of GWL Lowering of GWL Additional banking Soil improvement and reinforcement	Hazard map Appropriate land use Regulation of land use in hazardous area Insurance	Restriction of land use Evacuation from dangerous area Public support for evacuation
Slope failure	Protective pile Geosynthetics reinforcement Early warning system and evacuation system	Hazard map Risk map Regulation of land use in hazardous area Insurance	Restriction of land use Evacuation from dangerous area Public support for evacuation
Coastal erosion	Seawater protection work Conservation and replanting mangrove forest Early warning system of extreme weather events and evacuation system	Hazard map Risk map Regulation of land use in hazardous area Integrated coastal zone management Insurance	Restriction of wetland use Evacuation from dangerous area Public support for evacuation

In Vietnam side, the presentation showed the risk of sea level rise and its impaction to rural coastal area of Vietnam and focused on case study in Hai Hau district, Nam Dinh province. This is sensitive area and often facing the direct impaction from hydro-dynamics caused by tide, wave and other hydro-meteorological phenomena as well as long-term climate change and sea level rise. Detail findings are shown in item 3.3.

Another workshop in co-operation with Bonn University, Germany was held from 22 to 23 September 2010 with the topic of *"Mitigation of Hazard Risk in Response to Climate Change".* Actually the workshop has a broader focus for both mountainous and coastal areas, river basin and lowland areas. It attracted however a wider range of participants. Several outstanding experts from universities, NGOs, and ministries had joined and had presentations. We should mention the presentations of very active experts in the field of climate change research. Dr. Nguyen Quang (UN-

HABITAT) gave a presentation on *"Urban Development and Climate Change Adaptation in Vietnam"*, where he mentioned challenges, experiences, relating policies, and some initial achievement in the practice of Vietnam. Mr. Bach Tan Sinh (National Institute for S&T Policy and Strategic Studies) with *"Cities Adapting to Climate Change – Rockefeller Foundation Projects*" once again emphasized the impacts of climate change to urban areas of Vietnam. The following presentations of Prof. Dr. Tran Nghi (HUS) - *"Sea Level Rise and Environmental Impacts in the Mekong River Delta"* and Dr. Koos Nefjes - Special Advisor of UNDP to the Government of Vietnam - *"Climate Change Adaptation Challenges in Vietnam*" gave a broader discussion about sea level rise and climate change to Vietnam. These two emphasized more on the impacts to the rural areas which indicated that the low awareness of local residents can increase vulnerability.

3.2. Enhance awareness of local residents and authority

Members of the project had 2 periods of fieldtrip which focused on the investigation and enhancement of local awareness. Several meetings with local authority at district, commune levels and residents had carried out. Questions about evidences and impacts of climate change were asked. The first field trip through these conversations decided the tentative main topics of workshop in Hai Dong commune, Hai Hau district. Local residents are almost have heard about climate change and sea level rise, but they do not know or even imagine what it is. A question about damages of climate change always leads to the description of the damages caused by typhoon, storm surge, saline intrusion, and/or seadike broken. However most of people confirmed that typhoons seemed to be more severe in recent years. Agricultural productivity was reduced due to saline intrusion. Some new strange insects have appeared that damaged seriously cultivation.

After the first field trip a training workshop was organized in Hai Dong commune, Hai Hau district (Fig. 1). The main objective of this workshop is to help the local government understand and gather knowledge on the impactions of geohazards in Vietnam coastal zone and especially focus the geohazards of sea dike erosion and flooding in Hai Hau place. The presentations also suggest the solutions on measures of non-structures and structure that should be applied in Hai Hau to mitigate the damage due to those hazard risks. The presentation of the project leader on "Community-based for Disaster Risk Reduction in the Context of Climate Change" mentioned to the necessity of local participation, especially at extreme events. Community-based approach is mainly focused on principal 4 local guidelines such as (i) Local manager; (ii) Local combat forces; (iii) Local means and materials; and (iv) Local logistics. The presentation was interested to both the local governments and local community.

During the workshop, the science professional and the participants had opened discussion, the questions and problems given by local community helped the science to collect more information and do more successfully the project activities. The local authority indicated that saline intrusion through surface water was largely expanded in recent years. Moreover salt water injected groundwater can seep through seadike foundation causing serious problems to agriculture and aquaculture in Hai Hau district. Hundreds thousand of people was immigrated during the typhoon No. 7 in 2005 therefore local people had high awareness about extreme weather events. However they complained about the quality of weather forecast, especially the intensity and landed place of typhoon. The actual intensity was sometimes much lower than forecasted. Infrastructural facilities are still far to meet requirements. Roads for urgent rehabilitation of seadikes or urgent people immigration are very limited in both quantity and quality. A field trip was then implemented along

the seadike system of Hai Hau. Members of the project had several conversations with local people (Fig. 2) and discussed with local authority about plan to adapt to extreme events and long-term impacts of sea level rise. Results of projects and these discussions help concerning scientists and local authority to make proposal and urge institutions at provincial and national levels on potential impacts of infrastructural development in the coastal zone of Hai Hau district.

Fig 1. The participants of the workshop

Fig 2. Discussion with local people in the field

3.3. Pilot study

Recognition of Climate Change

Change of temperature: During the last 50 years (1958-2007), the annual average temperature in Vietnam increased about 0.5 to 0.7^{0}C. Winter temperature increased faster than those of summer and temperatures in the North increased faster than those in the South. The annual average temperature for the last four decades (1961-2000) was higher than that of the three previous decades (1931-1960). Annual temperature for 1991-2000 in Hanoi was 0.8^{0}C higher than the average for 1931-1940 (MONRE, 2009).

Relative sea level rise in Vietnam is mainly calculated from tide-gauge data collected at the 4 chief stations: Hon Dau (Quang Ninh province - North Vietnam), Da Nang, Qui Nhon (Centre Part) and Vung Tau (South Vietnam). The longest tide data is achieved at Hon Dau station from 1960 to 2000. Herein a sea level rise of 1.9 mm a year has been observed in this period (Hanh & Furukawa, 2007). Nguyen Ngoc Thuy (1995) analyzed 2 tidal gauges in the North coast, one is at Hon Dau and another is at Hai Hau. The result shows that from 1950s to 1990s the average rate of sea level rise is 2.24 mm/y.

Tropical cyclone is a typical climatic event in the North Vietnam. The so-called typhoon season often starts in June and ends in October. About 13% of the total tropical cyclones landed on the North coast. Tropical cyclones, especially typhoons lead to many severe lost of properties and fatality. For instant the typhoon PAT (23 October 1998) made 500,000 homeless, 90 death in the North coast. The most recent statistical data of the annual number of tropical cyclones (Fig. 3) shows that the number of cyclones does not have any clear trend during the period 1960s - 1990s. It only had a significant reduction from 2000-2004 and then has been increasing very rapidly from 2005 up to present. Such rapid change can not be met at any other period of time (from 1961 to 2008). This

matter can not all be claimed on climate change. However it is evidence showing that the variability of extreme events at the coast occurring more complicated with a wider range of the number.

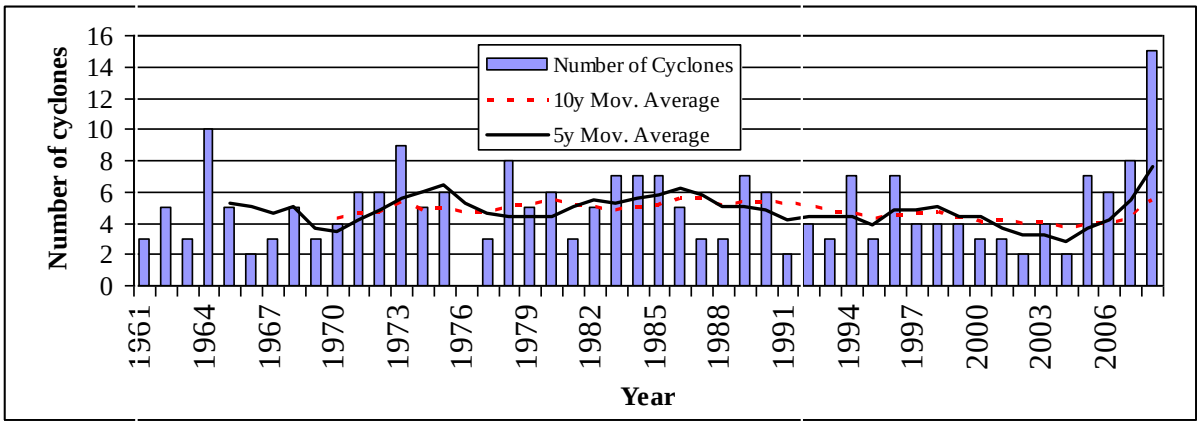

Fig. 3. Number of tropical cyclones attacked Vietnam coast (1961-2008)
(Data source: Website of Vietnam National Center for Meteorology and Hydrology)

Hai Hau coast erosion and adaptation

A pilot study was implemented in the coastal zone of Hai Hau district – the most severe erosion coast in the North Vietnam. Hai Hau is a district in costal zone of Nam Dinh province that has been formed by deposition process of the Red River delta system. Hai Hau is an important economic role in Nam Dinh province with of 54% and 53% of sea and salty production, respectively. The Hai Hau coast includes 7 communes such as Hai Loc, Hai Dong, Hai Ly, Hai Chinh, Hai Trieu, Hai Hoa, and Hai Thinh (Thinh Long town). The population density of 1,400 persons/km^2. Herein, the erosion has caused great damages on the local infrastructure and fatality that leads to significant disadvantages for social-economic development in the region.

The shoreline is a straight line directing from Northern East to Southern West in a distance of about 27 km. The slope is 1:40 in near the shore, and it is from 1: 350 to 1: 200 at the depth of over than 1 m. The slope decrease as the sea water depth increases. The shoreline is covered by fine sand with the thickness of 0.5 - 2m. That sandy layer is thinner seaward. The tidal amplitude is 2.5–3 m. Waves have main directions of East, Northeast in winter and East, Southeast in summer. The average height of waves is 0.7 - 1.3m and reach to 3.2 m in storms.

Hai Hau has been well-known as the most severe erosion coastal zone in the North of Viet Nam. The erosion has been studied in many researches carried out by the Government, Local Authority, and scientific institutions. In these studies, Hai Hau was considered as high wave energy coast (classification of Davis & Hayes, 1984).

The erosion in Hai Hau district has started since the beginning of the XX century (from 1905). This erosion has a close relation to the degradation of the Ha Lan river mouth (the former main river mouth of the Red River system at that time). The clear evidence of the Ha Lan mouth degradation can be found at Giao Long, Giao Phong shoreline where was continuously deposited with great speed (reaching to 200 m/year in some segment during the period 1905-1930) (Fig. 4). However the shoreline was then changed to erosion. The main river mouth was shifted to the Ba Lat the mouth. The length of erosion segment increased gradually to the 1980s, and then it has a tendency of shortening because the shoreline was protected by the sea dike system. However, the erosion

intensity increases clearly from 1985 to 1995, more 1.5 times than from 1965 to 1985. Especially, the erosion speed reaches 15-20m/year at the Hai Chinh – Hai Hoa shoreline. The erosion usually takes place stronger in the northeast wind season and has a tendency of moving southwestward to Hai Thinh commune with of the average speed of 400m/year. Erosion has caused a lot of damages to the coastal zone (Fig. 5 & 6).

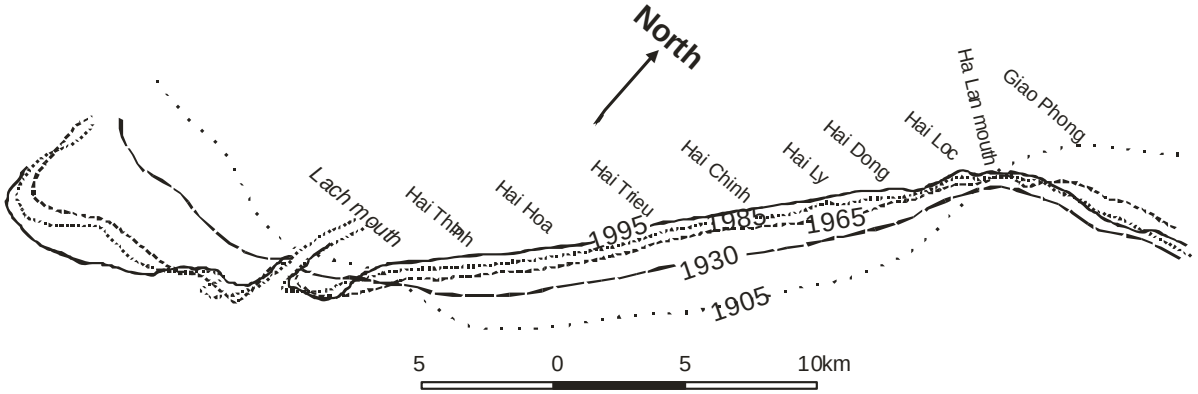

Fig. 4. Shoreline change of Hai Hau coast and surrounding area

Fig. 5. Land loss due to erosion in Hai Ly

Fig. 6. Former seadike in Hai Hau

At the Hai Hau coastal zone the factors controlling erosion process includes endogenous (modern tectonics), exogenous (mainly in the hydrosphere) and human activity (Fig. 7). These factors have relationship and interact in one identical system that controls the balance of erosion process. The reasons of erosion therefore should be evaluated by their influence and interaction.

Hai Hau coastal zone is situated between two big river mouths such as Ba Lat in the north and Lach Giang in the south. The annual sediment amounts transported through these river mouths are 29.1 and 5.82 million tons (period 1956 – 1998), respectively. According to the method of Gao & Collins, 1992, the net sediment transport pathways are referred from grain-sizes (Fig. 8). It shows that the sediment from the Ba Lat mouth is not deposited nearshore, but moves seaward up to the water depth of 25 m. It is clear in the Giao Long - Hai Loc segment at the depth of 5-25m. In Hai Thinh shoreline, the sediment is transported along the coast southwestward. In Giao Long- Giao Phong shoreline, the sediment is transported along coast northeastward. Its reason may be the waves created by northeast winds do not have strong effect on the segment because of the sandy bars in

front of the Red River mouth. The seacoast is eroded by southeast wave and the sediment is transported southwestward.

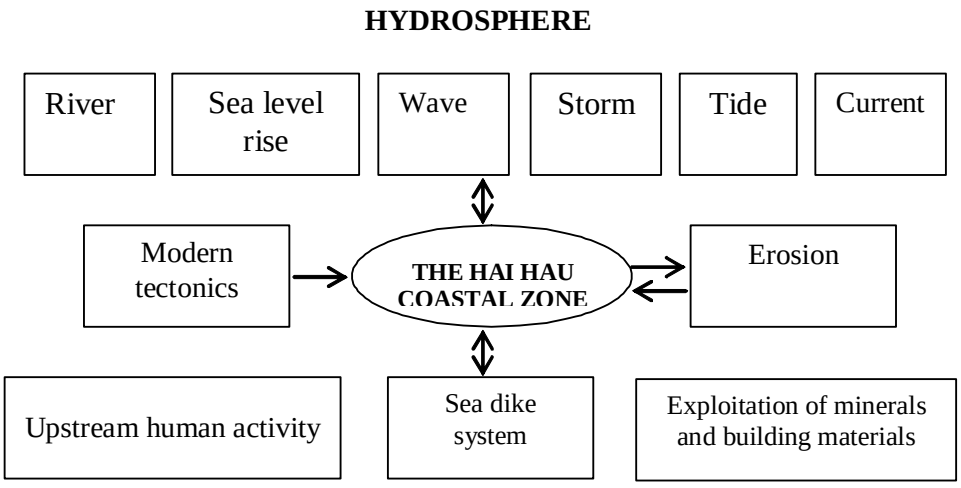

Fig. 7. The interacting system at Hai Hau coast

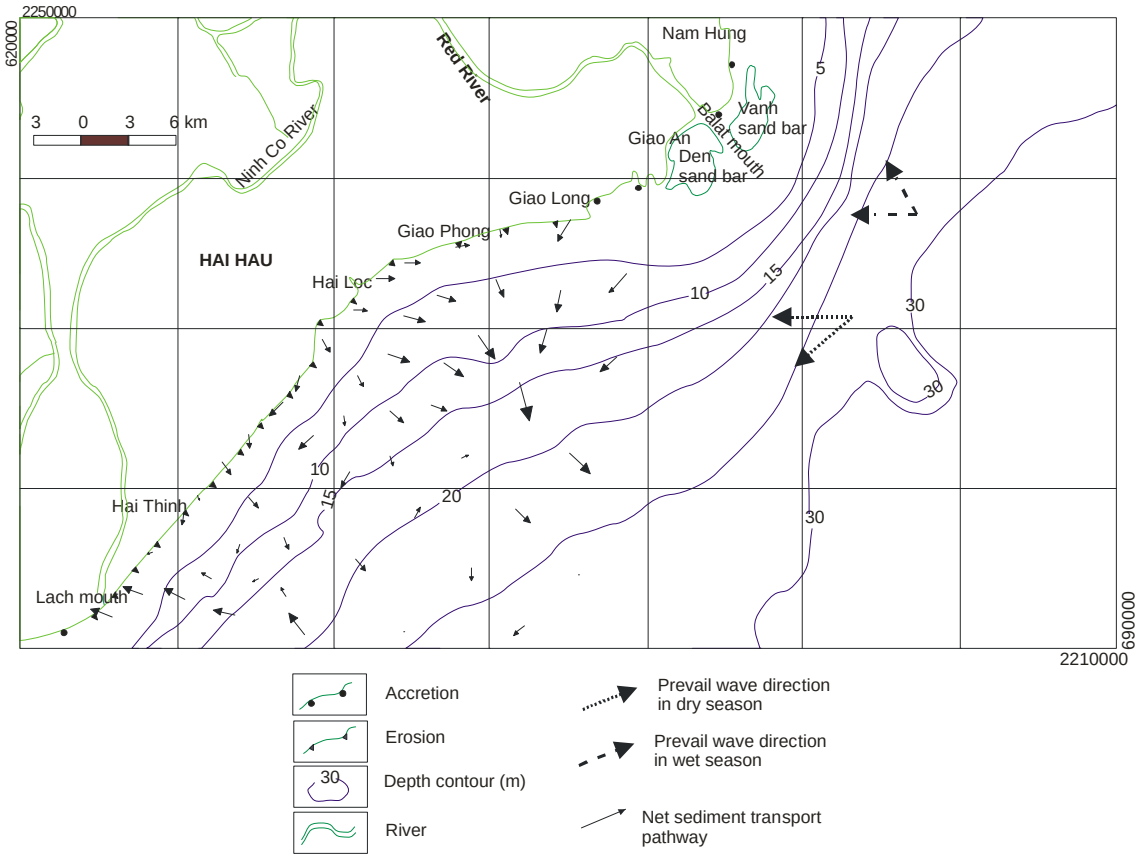

Fig. 8. Net sediment transport pathway at the Hai Hau coast

The alongshore sediment transport is calculated by CERC equation (Manual of Coastal Engineering, 2002) with the wave monitoring data at Hai Hau from 1976 to 1994. The cross-shore sediment transport is calculated by the equation of Kajima et. all (1982). The result of (Duc, 2002) shows that the volume of alongshore sediment transport southwestward is 654,078 m^3/year. The sediment is mainly transported to the southwest by the northeast and east waves. Some periods in summer, the

dominant wind direction is southeast and south, and in such cases the sediment is transported northeastward with the average volume of 62,884 m^3/year. However, the net alongshore sediment transport is southwestward. The volume of cross-shore sediment transport is 1,286,322 m^3/year. Therefore the sediment volume moved out of the near shore zone is 1,940,000m^3/year (38% along the seashore and 62% far away).

Nowadays, the shoreline from Hai Loc to Hai Dong has been changed to accretion; however the erosion can continue to increase in other segments. The concrete dike system in Hai Dong - Hai Hoa leads to stronger wave power that affects the shoreline in the south west, and shifts the most severe erosion segment to Hai Thinh commune.

Impacts of the river dike system: reducing the flow channel, increasing the flow power to the sea, and decrease sediment supply to the region near river mouths. The Red River dike also plays important role to set up the fact that the delta only develops strongly in the north (Van Uc, Tra Ly river mouths), center area (Ba Lat river mouth), and in the south (Lach Giang, Day mouths). The areas between river mouths are not supplied with sediments leading to erosion segments, among that Hai Hau is a typical case.

Impacts of upstream hydropower plants: Hoa Binh hydropower plant reduces 56% the sediment supply to the down stream. The accretion rate decreased from 84mm/year (1965-1985) to 60mm/year (1985-1995) at the Ba Lat mouth. In the near future, as Tuyen Quang, Son La and other hydropower plants will be operating the sediment supply for the coast is going to decrease significantly. Therefore the reduction of accretion at the river mouths and more severe erosion in the Hai Hau coast could be practical.

Impacts of human activity in the coastal zone: the most important activity is the construction of sea dikes. Before 1998, the dike was built manually with 4m in height, 1:2 in slope and the side toward to sea was covered by rock with average size of 30cm. This dike system is weak and has a high risk in typhoon. To prevent the damages as the dike destroyed, the standby dike system was built with a distance of 150-200m from sea exposed dikes. Actually, both two dike systems are weak and can stand for short time. They were almost disappeared after 10 years on average. Nowadays, most the dikes in Hai Hau were rebuilt with concrete. It is much stronger but they still can not suffer from surge storms in spring tide. Moreover, the problem of scouring is not rationally solved. The activity of the building material and mineral exploitation in Hai Thinh coastal zone a few years ago also led to stronger erosion in the region.

Current coastal protection

Seadikes mainly constituted by soils were very common in the 1980s. The construction is simple. The dykes are easy to be eroded and severely damaged in a typhoon. Such type of dikes is still at some parts of Hai Hau coast as in Hai Chinh and Hai Dong communes. To reinforce the dykes groins are used. The groins are built by the cementing steel rod tube with thickness of 10cm, diameter of 1m, and placed continue in the depth of 0.5m under tidal flat, the height of 1.5m with the sand - bag inside. The distance between the soldering is 80m (Fig. 9).
Mangrove forest is a good measure against coastal erosion. A hundred meters of mature mangrove can reduce 0.1 m of wave height. However it can not be used in areas of severe erosion. Mangrove is now replanted in Hai Dong (Fig. 10) where the coast now turns to be accreted.

With the investment of PAM and the government from 1998 upto now, the sea dike system in Hai Hau was intensively reinforced. The height of dikes extends to + 4.5-5.5 m. The dike footing was

placed at the depth of 1.5 m. The dike was reinforced by lines of tripods and covered by polygonal pre-cast concrete with the mass of 100 kg, even reaching to 200kg on the slope of 1: 2.2-3 (Fig. 11). In the segments of soil dykes the standby blocks of limestone are disposed just nearby for emergence rehabilitation in bad weather conditions (Fig. 12).

Fig. 9. Revetment and groins

Fig. 10. Mangrove plantation

Fig. 11. New concrete dike

Fig. 12. Standby limestone blocks

Impacts of Extreme Events on Coastal Stability

The wave attacks on the dikes changes strongly depend on the wave heights. The average wave height produces 0.15-0.3 kG/cm^2. Waves in storm with the height of 3.2 m can derive a load of 0.8 kG/cm^2 on the surface of the dikes. According the calculation of Duc, 2003 waves in typhoons or storm surges with the height of over 2 m can make the small seadike (constituted mainly by soils and rocks) failure even in the mean tide. The concrete seadike can be instable when extreme wave heights in typhoons can run up over the top of the dike. Therefore SLR not only leads to stronger pressure on seadikes but also strengthens the seawater run up during typhoons and storm surges.

Besides in a typhoon strong winds and heavy rainfall raise the seawater level. A strong typhoon can raise the water level 1.1 - 3.2 m (Table 2). The typhoon Damrey landed in the high spring tide caused very disastrous damages on seadikes, mangrove, shrimp ponds and infrastructure. A large area of paddy fields was inundated and salinized. A few hundred thousands people had to immigrate.

Table 2. Level of storm-surge in typhoons

No.	Typhoon	Date	Landed place	Storm surge (m)
1	ROSE	13/08/1968	Nam Dinh	2.56
2	RUTH	19/10/1973	Thanh Hoa	2.50
3	JOE	23/08/1980	Hai Phong	1.94
4	KELLY	04/07/1981	Nam Dinh, Ninh Binh	2.50
5	WARREN	28/08/1981	Thai Binh, Nam Dinh	1.15
6	NANCY	18/10/1982	Thanh Hoa	3.20
7	PAT	23/10/1988	Hai Phong	0.78
8	DOST	12/06/1989	Hai Phong	1.92
9	PHYLIPS	02/07/1996	Nam Dinh, Ninh Binh	1.10
10	DAMREY	26/9/2005	Nam Dinh, Hai Phong	2.5-3.0

Long-term Impacts on Coastal Stability

To estimate the increase of shoreline erosion the formula of Bruun or the so-called Bruun rule (described in the Manual of Coastal Engineering, 2002) is used. The formula shows the relation between SLR and the increase of shoreline erosion as following:

$$R_{\infty} = 0{,}001S\frac{L_*}{h_* + B}$$

of which: S - SLR (mm/y)

R_{∞} - Exceeding rate of erosion due to SLR (m/y)

L* and (h*+B) are the width and vertical extent of the active profile

The exceed erosion rate due to SLR is about 0.2 m/y (Table 3). As a raw estimation SLR can cause 10-50% of the exceeding rate during the periods 1985-1995 and 1995-1999.

Table 3. The Exceeding rate of shoreline erosion due to SLR

Location	***SLR (mm/y)***	***h**** ***(m)***	***B (m)***	***A*** ***($m^{1/3}$)***	***L**** ***(m)***	***R_{∞} (m/y)***
Hai Loc	2.24	5.4	2.0	0.0798	556.7	0.17
Hai Thinh	2.24	7.0	2.0	0.0798	821.6	0.20

In front of the sea dykes, the shoreline does not keep moving landward and erosion changes from horizontal to vertical direction that lowers the beach relief and causing scouring. The rate of lowering was approximately estimated by physical model of Barnett & Wang (Manual of Coastal Engineering, 2002). Assuming the volume of sediment transported is similar to the value before the construction of the dykes, then the relation between erosion rate and lowering rate can be refrerred as follows:

$$\Delta h = 100\Delta Y \times b / l$$

where: Δh - Lowering rate (cm/y)
ΔY - Erosion rate (m/y)
l - Width of beach from shoreline to the depth of mean sea level (m)
b - Height of berm (m).

The calculation shows that lowering rates are high at Hai Ly, Hai Chinh, Hai Trieu, and Hai Hoa (Table 4) with the values of 15-25 cm/y. As presented above the current concrete dykes have foots placed at the depth of 1.5 m. With those lowering rates, the dike's trough can be destroyed in 6-10 years.

Table 4. Lowering rate of Hai Hau coast

Location	Beach angle	Height of berm (m)	Width of beach (m)	Erosion rate (m/y)	Lowering rate (cm/y)
Hai Dong	0.0150	2.5	200	5.0	**6.3**
Hai Ly	0.0150	2.5	180	12.0	**16.7**
Hai Chinh	0.0150	2.5	250	15.0	**15.0**
Hai Trieu	0.0150	2.5	225	20.0	**22.2**
Hai Hoa	0.0100	2.5	210	21.0	**25.0**
Hai Thinh	0.0100	2.5	260	7.0	**6.7**

Rational landuse in Hai Hau coast

With the high population density and economic benefits, the protection of the Hai Hau costal zone is very important. As presented above, the coastal erosion in Hai Hau always has high intensity and complex changes along different time and spatial periods. Herein, the erosion has bad direct impacts to the sea dike stability, reduces the area of land for living, mangrove forest, aquaculture and agriculture; at the same time it increases saline intrusion, making difficult condition for tourist development, salty production, exploitation of minerals and building materials. Especially, as before years, the surge storms destroyed sea dikes and people had to move to other safe places. With the emigrant, it is not only need the land capacity but also the need of jobs for almost population who have only known aquaculture, fishing, and salty production.

The counter measures for coastal protection can referred from the experience of Japan (Table ??). Wave energy reduction measures such as breakwater, beach nourishment are still not to be used in Vietnam. However mangrove forest is more friendly to the environment. One of the priority in next co-operation research is to explore possibility of using geosynthetics for coastal protection. The research is expected to focus on geotube as breakwater to protect the coast of Hai Hau.

In the mean time, the concrete measure can not afford severe weather condition such as typhoon at level of 11 or stronger (Beaufort scale) landing during mean or spring tide. Therefore, the suitable landuse in the Hai Hau coast needs both technical and social-economic measures that means the problem can be better solved with the approach of integrated costal zone management (ICZM). To establish the ICZM for Hai Hau it is necessary to implement a study with respect to social–economy, management, and having close combination with research agency, governmental institutions and local people.

Table 5. Concrete measures against coastal erosion in Vietnam and Japan

Country	Countermeasures	Issues to be resolved
Vietnam	Mangrove plantation Revetment Groin Concrete block	Lack of natural data Lack of study into causes and erosion mechanism Failures due to material deterioration Not successful structural solutions
Japan	Geo-tube Coastal dike Sea wall Groin Detached breakwater Artificial nourishment	The same issues as those above Advanced knowledge from synergetic cooperation Application of ICT Establishing the adaptation concept

3.4. Towards wise adaptation to the climate change

Results of the project's workshops can help to set some fundamentals to have a wise adaptation to climate change in the condition of developing countries. According to IPCC, reduction of climate change impacts includes mitigation (reduce GHGs emission) and adaptation (adjustment of natural and human systems to cope with warmer world). A portfolio of adaptation and mitigation is the only way to diminish the risks associated with climate change. For developing countries, adaptation is much more important. It is also strongly mentioned in the National Target Programme to Respond to Climate Change of Vietnam.

Asia-Pacific area is now facing the challenges related to climate change such as:

+) Asian cities in low-lying deltas will be increasingly at risk.

- Impacts of climate change and SLR
- Large population growth and development

+) Development policies and city management aim mainly at short-term goals.

- Today's problems
- Large portion of today's investments will be affected by CC/SLR, i.e. 10 to 50% of investment to infrastructure such as coastal dikes, loads, bridges, irrigation facilities.

+) How to incorporate the future risk of CC/SLR into today's management.

- Role of adaptation: increase the preparedness with solving today's problems
- Win-Win approach both to present and future problems
- Mainstreaming adaptation

+) Major target of adaptation for coastal cities is management of growth.

- Impact and vulnerability assessment is the first step.
- Regulate migration of population
- Incorporate adaptation to CC in to infrastructure construction and city planning

The adaptation combines three options retreat, accommodation, and protection (Table 6). Retreat is used where designed structures can not suffer the potential bad impacts. Accommodation is adjustment in living patterns to reduce disadvantages of climate change. Protection focuses on concrete and soft measures to protect societies from risks.

Table 6. Adaptation options

Retreat	<u>Move from dangerous areas</u> Development regulation for disaster-prone coastal areas Land use planning Evacuation from highly vulnerable coastal areas Immigration
Accommodation	<u>Change use and living patterns</u> Changes of land use patterns Protection of mangroves Disaster insurance
Protection	<u>Protect societies from risks</u> Protection by hard structural measures - Dikes, seawalls, floodgates - Anti-erosion measures - Water resource management Protection by soft technologies - Anti-erosion measures - Conservation of coastal ecosystems - Early-warning systems - Evacuation practices - Awareness raising

Each place requires different adaptive measures depending on the actual condition of the site. It should normally be cost-benefit and meet requirements of multi-sectors in both short-term and long-term periods. Therefore the wise adaptation is necessary. The main concerning issues are:

- How to plan adaptation under uncertainties in climate projection, effects of mitigation, social changes, etc?
- Introduce effective, efficient, flexible adaptation.
- Short-term and long-term planning.

Where:

1) Short-term adaptation
   - Respond to occurring climatic extremes
   - Monitoring/early warning e.g. new radar system
   - Evacuation
2) Long-term adaptation - flexible adjustment of adaptation planning

Wise adaptation combines some elements as following:

1. Impact/vulnerability assessment at local level
2. Monitor and early warning
3. Soft options first, then hard options
4. Incorporate CC adaptation to renewal cycle of infrastructure
5. Co-benefit approaches for mitigation and adaptation
6. Collaboration of ministries
7. Participation of stakeholders and capacity building

Wise adaptation must include the sustainability as developing countries are already vulnerable to the present climatic conditions, win-win approach is effective to developing countries. “Win-win” means to be effective both to the present vulnerability and future impacts. Increase of the responsive ability to the current disasters will also strengthen their preparedness and resilience to the impacts of future climate change.

The success of adaptation depends on the adaptive capacity (i.e. resilience) of each country and local community.

- Enhancing adaptive capacity to the current climate variability and future climate change is one of the most important goals of an adaptation policy.
- From this viewpoint, it is also important to utilize and enhance the local and indigenous knowledge.
- It is a major challenge to incorporate the traditional knowledge and technologies in modern science and technology.

Wise adaptation is to improve society’s resilience to climate change and human security also constitutes an important policy towards achieving sustainable development. It is not a single policy, but a comprehensive approach to development policies, such as poverty reduction, agricultural development, water resources management and disaster prevention.

4.0 Conclusions

The project aims to help the local authority to know the new risks of climate change and gain initiative in adaptation to climate change, capacity development and exchange of experiences on climate change risk assessment and coastal protection.

Training workshop and working with local people in Hau Hau district have brought them better understanding about the impacts of climate change. They can even recognize the impacts of climate change to agriculture and aquaculture. However they do not have any ideas about adaptive measures, but are very interested on protective measures against extreme climate events.

The presentations of Japanese, German, and Vietnamese experts in two scientific workshops have provided scientists, especially young people to learn and exchange the ideas about climate change. A comparative study on counter measures coastal protection between Hai Hau (Vietnam) and Japan confirms the important role of natural and socio-economic conditions. The developing countries can not use concrete measures along the coast, but need wise adaptation.

Wise adaptation includes elements such as impact/vulnerability assessment at local level; monitor and early warning; soft options first, then hard options; incorporate climate change adaptation to renewal cycle of infrastructure; co-benefit approaches for mitigation and adaptation; collaboration of ministries; and participation of stakeholders and capacity building.

5.0 Future Directions

Referring from results of the project the potential directions of future activities may include:

- Estimation of socio-economic loss due to climate change in the coastal zone;

- Link adaptive measures to landuse planning at local levels, i.e. districts and communes;

- Enhancement the awareness of short-term and long-term impacts of climate change;

- Setting up a web-based community of young scientists concerning climate change research.

References

Brunn, P., 1962. Sea-level rise as a cause of shore erosion. Journal of Waterways and Harbor Division, American Society of Civil Engineers, Vol. 88, 117-130.

Coleman, J. M., and Wright, L. D., 1975. Modern river deltas: Variability of process and sand bodies, in: Broussard, M. L. (ed.), Deltas, Models for Exploration, Houston Geological Society, Houston, TX, pp. 99-149.

Davis, R.A. and Hayes, M.O. (1984). "What is a Wave-Dominated Coast ?", Marine Geology, Vol. 60, p. 313-229.

Duc, D.M, Nhuan, M. T., Ngoi, C. V., Tran Nghi, Tien, D. M., van Weering, Tj. C. E., van den Bergh, G. D., 2007. Sediment distribution and transport at the nearshore zone of the Red River delta, Northern Vietnam. Journal of Asian Earth Sciences, Vol. 29, Issue 4, 588-565.

Do Minh Duc (2002). "The Reasons of Coastal Erosion in Hai Hau District, Nam Dinh Province", *Scientific Workshop No. 15 in Hanoi University of Geology-Mining.*

Do Minh Duc (2003). "The Model for the Sea Dike Stability Analysis". *The Science – Mining Technology Journal No. 3/2003.*

Gao, S. and Collins, M. (1992). Net Sediment Transport Patterns Inferred from Grain-size Trends, Based upon Definition of "Transport Vectors". *Sedimentary Geology, Vol. 80, 1992. p.47-60.*

Hoan, N., and Phai, V. V., 1995. Topographical change and the formation of sand bars in the Red River (Ba Lat) mouth. Vietnam National University, Hanoi's Project report, pp. 66 (in Vietnamese).

Hoekstra, P. and van Weering, Tj.C.E., 2007. Morphodynamics of the Red River delta, Vietnam: Introduction to the special issue. Journal of Asian Earth Sciences, Vol. 29, Issue 4, 505-507.

Kriebel, D. L., and Dean, R. G., 1993. Convolution method for time-dependent beach-profile response. Journal of Waterway, Port, Coastal and Ocean Engineering, American Society of Civil Engineers, Vol. 119, No. 2, 204-227.

Ministry of Natural Resources and Environment (MONRE) (2009). *Climate Change, Sea Level Rise Scenarios for Vietnam.*

Nhuan, M. T., Hai, T.Q., Ngoi, C.V., Manh, L.V., and Vi, P.V., 1996. Establishing Environmental Geological map of shallow sea (0-30 m deep) in Ngason – Haiphong area, scale 1: 500,000, pp. 94 (in Vietnamese).

Nguyen Ngoc Thuy (1995). *The South China Sea Tide and Sea Level Change in Vietnam Coastal Zone.* Research KT-03-03, National Program KT-03. 195pages.

Pham Thi Thuy Hanh and Masahide Furukawa, 2007. Impact of Sea Level Rise on Coastal Zone of Vietnam. *Bull. Fac. ScL, Univ. Ryukyus*, No.84 : 45 - 59 (2007).

Pruszak, Z., Szmytkiewicz, M., Hung, N. M., and Ninh, P. V., 2002. Coastal processes in the Red River delta area, Vietnam. Coastal Engineering Journal, Vol. 44, No.2, 97-126.

U.S. Army Corps of Engineers (2002). *Manual of Coastal Engineering.*

Van den Bergh, G.D., Boer, W., Schaapveld, M.A.S., Duc, D.M., and van Weering, Tj.C.E., 2007. Recent sedimentation and sediment accumulation rates of the Ba Lat prodelta (Red River, Vietnam). Journal of Asian Earth Sciences, Vol. 29, Issue 4, 545-557.

Vinh, T. T., et al. (1996). "Sea Dike Erosion and Coastal Retreat at Nam Ha Province, Vietnam". *Coastal Engineering 1996, Chapter 28, p. 2820-2828.*

Appendix

1. Short report on Seminar on 28 July 2010 in Hanoi University of Science

2. Short report of the Workshop on 18 September 2010 in Hai Hau District, Nam Dinh Province

3. Short report of the Workshop on 22-23 September 2010 in Hanoi

4. List of young scientists

Short report on Seminar on 28 July 2010

Hanoi University of Science

CAPACITY DEVELOPMENT FOR ADAPTATION TO CLIMATE CHANGE IN THE RURAL COASTAL ZONE OF VIETNAM

The Seminar ***"Capacity Development for Adaptation to Climate Change in the Rural Coastal Zone of Vietnam"*** is an activity that belongs to The Project of CIA2009-06-Duc. This is a good opportunity to exchange research experience and knowledge on adaptation the impactions of climate change and geo-hazards in the coastal zone between the Japanese and Vietnam scientists. The Seminar was hold on:

1. Date: Weds, 28 July 2010

2. Venue: Room 418 Building T1, Hanoi University of Science

334 Nguyen Trai street, Thanh Xuan district, Hanoi city, Vietnam

3. Organization Board:

No.	Full name	Title	Affiliations
1	Nguyen Hoang Luong	Prof. Dr. Sc.	Vice-Rector of Hanoi University of Science (HUS)
2	Do Minh Duc	Assoc. Prof. Dr.	Deputy-Dean, Faculty of Geology, Hanoi University of Science
3	Nobuo Mimura	Prof. Dr.	Ibaraki University
4	Kazuya Yasuhara	Prof. Dr.	Ibaraki University
5	Nguyen Thi Minh Thuyet	Dr.	Hanoi University of Science
6	Duong Thi Toan	MSc.	Hanoi University of Science

4. The Partners and Participants

The partners and participants were invited in open attending that come from:

- All most staff members in Faculty of Earth Science in HUS: Geology; Geography, Environment, Meteorology – Hydrogeology – Oceanography

- Vietnam Geotechnical Institute
- Institute of Geology, Geography
- Hanoi Water Resource Trace Institute
- Institute of Science on Geology and Mineral
- Hanoi University of Geology and Mining
- Hanoi Water Resource University
- Ministry of Agriculture an Rural Development

The list of participants in the seminar

No.	Last Name	Title	Organization
1	Nguyen Hoang Luong	Prof. Dr.	Vice- Rector , HUS
2	Phan Duy Nga	Mr.	Head of Department of International Relations and Aministration, HUS

No.	Last Name	Title	Organization
3	Tran Thi Hong	Assoc. Prof. Dr.	Head of Department of Science and Technology, HUS
4	Duong Anh Tuyen	Dr.	Vietnam Human Resource Development Department
5	Ha The Dinh	Mr.	Hanoi Water Resource Trace Institute
6	Le Thi Mai	Ms.	Hanoi Water Resource Trace Institute
7	Le Canh Tuan	Dr.	Hanoi College of Environment Resource
8	Bui Thi Tuyet	Ms.	Center of Environment Education and Communicate
9	Dang Hoang Ha	Mr.	Center for water resources Planning and Investigation
10	Vu Quoc Chinh	Dr.	Vietnam Civil Engineering Society
11	Dinh Van Thuan	Mr.	Institute of Geology
12	Do Thi Nhinh	Ms	Institute of Geography
13	Vu Van Phai	Dr.	Faculty of Geography, HUS
14	Nguyen Hong Quang	Mr.	Institute of Science on Geology and Mineral
15	Ta Trong Thang	Assoc. Prof.	Faculty of Geology, HUS
16	Nguyen Dinh Nguyen	Mr.	Faculty of Geology, HUS
17	Hoang Minh Hien	Dr.	Ministry of Agriculture an Rural Development
18	Nguyen Ngoc Thach	Assoc. Prof.	Faculty of Geography, HUS
19	Nguyen Huy Phuong	Assoc. Prof.	Hanoi University of Geology and Mining
20	Pham Quang Tuan	Assoc. Prof.	Faculty of Geography, HUS
21	Nguyen Thi Vinh Ha	Ms.	Hanoi University of Economics, Vietnam National University, Hanoi
22	Nguyen Thi Ha	Ms.	Faculty of Environment, HUS
23	Tran Dang Quy	Mr.	Faculty of Geology, HUS
24	Pham Duc Thanh	Dr.	Hanoi Water Resource University
25	Nguyen Thi Hong	Ms.	Faculty of Geology, HUS
26	Pham Huu Sy	Assoc. Prof.	Hanoi Water Resource University
27	Nguyen Viet Tinh	Dr.	Hanoi University of Geology and Mining
28	Dinh Van Thang	Dr.	Hanoi University of Geology and Mining

No.	Last Name	Title	Organization
29	Tran Anh Tuan	Dr.	Rector, Institute of Geology
30	Vu Cao Minh	Assoc. Prof.	Institute of Geology
31	Mai Trong Thong	Assoc. Prof.	Institute of Geography
32	Doan Dinh Lam	Dr.	Institute of Geology
33	Vu Trong Hoang	Dr.	Institute of Geography
34	Nguyen Xuan Cu	Assoc. Prof.	Faculty of Environment, HUS
35	Tran Van Tuy	Mr.	Faculty of Environment, HUS
36	Luu Duc Hai	Assoc. Prof.	Faculty of Environment, HUS
37	Nguyen Minh Huan	Assoc. Prof.	Faculty of Meteorology – Hydrogeology – Oceanography, HUS
38	Dinh Xuan Thanh	Mr.	Faculty of Geology, HUS
39	Nguyen Thi Thanh Hang	Ms.	Hanoi Water Resource Trace Institute
40	Nguyen Dang Son	Dr.	Vietnam Civil Engineering Society
41	Duong Thanh	Mr.	Journal of Rural Economics
42	Dang Van Luyen	Mr.	Faculty of Geology, HUS
43	Nguyen Thi Kim Cuc	Ms.	Hanoi Water Resource University
44	Dang Ngoc Thuy	Dr.	Center for water resources Planning and Investigation
45	Vu Van Tich	Dr.	Faculty of Geology, HUS
46	Nghiem Huu Hanh	Assoc. Prof.	Rector, Vietnam Geotechnical Institute
47	Dang Mai	Assoc. Prof.	Faculty of Geology, HUS
48	Hoang Minh Thao	Dr.	Faculty of Geology, HUS
49	Nguyen Hieu	Assoc. Prof.	Faculty of Geography, HUS

5. The Objective and Technical Program:

Objective: The main objective of this Seminar is discussion and exchanges research experience on the current problems that focused on sea dyke system erosion and its solutions.

In this Seminar, the Japanese Science presented the overview the problem in the Asia Pacific caused by global climate change, the problems relative to typhoon, Inundation, global mean sea level rise and all these impaction to increasing geo-hazard in coastal zone area. The technical solutions also were given for sea dike erosion with some case study in Japanese coastal zone. On Vietnam site, the

presentation showed the risk of sea level rise and its impaction to rural coastal area of Vietnam and focused on case study in project study area as Hai Hau district, Nam Dinh province, This is sensitive area and often facing the direct impaction from hydro-dynamics caused by tide, wave and other hydro-meteorological phenomena as well as long-term global climate change and sea level rise.

Technical Program

Weds, 28 July 2010: Seminar on Hanoi

8h30– 9h00	Registration
9h00 – 9h15	Opening ceremony - Prof. Dr. Sc. Nguyen Hoang Luong, Vice-Rector of Hanoi University of Science with his speech well come and present HUS supporting on the project - Prof. Dr. Nobuo Mimura with his speech present the kindly cooperation between Hanoi University of Science and Ibaraki University.
9h15 –10h15	Prof. Nobuo Mimura: Challenges of climate change for the world, particularly Asia Pacific and adaptive solution
10h15 – 10h30	*Tea break*
10h30 – 11h30	Prof. Yasuhara: Effects of Climate Change on Coastal Zones in Japan
11h30 – 12h00	Dr. Do Minh Duc: Risk of sea level rise in rural coastal areas of Vietnam
14h00:	Going to the Hai Hau district, Nam Dinh province

Thurdays, 29 July 2010: Field trip in Hai Hau coastal area, Nam Dinh province

The list of members joined the field trip:

1. Assoc. Prof. Dr. Do Minh Duc, Faculty of Geology, HUS
2. Assoc. Prof. Dr. Chu Van Ngoi, Faculty of Geology, HUS
3. Prof. Dr. Nobuo Mimura, Ibaraki University
4. Prof. Dr. Kazuya Yasuhara, Ibaraki University
5. MSc. Dang Van Luyen, Faculty of Geology, HUS
6. MSc. Duong Thi Toan, Faculty of Geology, HUS
7. Mr. Dang Quang Khang, Faculty of Geology, HUS
8. Ms. Nguyen Thuy Linh, graduated student, Faculty of Geology, HUS

6. Photographs

Fig 1. The participants of the seminar

Fig 2. Prof. Nobuo Mimura was presenting his research

Fig 3. Prof. Yasuhara was presenting his research

Fig 4. Assoc. Prof. Do Minh Duc was presenting his research

Fig 5. The investigation the problem of sea dike erosion in Hai Hau, Nam Dinh province

Fig 6. The group members jointed field trip on site of the old sea dike was broken due to storm in 2005, Hai Hau, Nam Dinh province

Short report of the Workshop on 18 September 2010
Hai Hau District, Nam Dinh Province

CAPACITY DEVELOPMENT FOR ADAPTATION TO CLIMATE CHANGE IN THE RURAL COASTAL ZONE OF VIETNAM

The Workshop ***"Capacity Development for Adaptation to Climate Change in the Rural Coastal Zone of Vietnam"*** is an activity that belongs to The Project of CIA2009-06-Duc. The Workshop was held on:

1. Date: Saturday, 18 September 2010

2. Venue: Hai Dong commune, Hai Hau District, Nam Dinh Province

3. Organization Board:

No.	Full name	Title	Affiliation
1	Nguyen Hoang Luong	Prof. Dr. Sc.	Vice-Rector of Hanoi University of Science, Vietnam National University, Hanoi (HUS, VNU, Hanoi)
2	Do Minh Duc	Assoc. Prof. Dr.	Deputy-Dean, Faculty of Geology, HUS, VNU, Hanoi
3	Duong Thi Toan	MSc.	Faculty of Geology, HUS, VNU, Hanoi

4. Participants

The participant from Hanoi

No.	Full name	Title	Affiliation
1	Do Minh Duc	Assoc. Prof. Dr.	Deputy-Dean, Faculty of Geology, HUS, VNU, Hanoi
2	Tran Manh Lieu	Assoc. Prof. Dr.Sc.	Director, Civil Engineering Board, Vietnam National University, Hanoi
3	Vu Mai Anh	MSc.	Secretary-general of President, Vietnam National University, Hanoi
4	Vu Cao Minh	Assoc. Prof. Dr.Sc.	Head, Department of Geotechnics, Faculty of Geology, HUS, VNU, Hanoi
5	Chu Van Ngoi	Assoc. Prof. Dr.	Faculty of Geology, HUS, VNU, Hanoi
6	Dang Van Luyen	MSc.	Faculty of Geology, HUS, VNU, Hanoi
7	Nguyen Van Thien	Dr.	Faculty of Environment, HUS, VNU, Hanoi
8	Duong Thi Toan	MSc.	Faculty of Geology, HUS, VNU, Hanoi
9	Dang Quang Khang	Mr.	Faculty of Geology, HUS, VNU, Hanoi

The local participants were the representative persons of the local government with the level of district to commune; the representative persons of people's unions in Hai Dong commune and some farmers in Hai Dong commune.

The list of participants

No.	Name	Affiliation
1	Vu Huy Han	Vice- President of Hai Hau District People's committee
2	Tran Van Chinh	Vice- President of Hai Hau District People's committee
3	Nguyen Van Canh	Head, Inspection Section, Hai Hau District
4	Nguyen Thanh Binh	Head, Department of Natural Resources & Environment
5	Nguyen Manh Dung	Office Manager, Hai Hau District
6	Dinh Xuan Vuong	Vice-Head, Department of Agriculture and Rural Development
7	Vu Van Hieu	Department of Agriculture and Rural Development
8	Nguyen Duc Hoan	Department of Agriculture and Rural Development
9	Tran Van Thuy	Department of Agriculture and Rural Development
10	Nguyen Manh Cuong	President of Hai Dong commune People's committee
11	Pham Van Hien	Party Committee Secretary, Hai Dong commune
12	Nguyen Trung Ta	Office Manager, Hai Dong commune
13	Nguyen The Du	Hai Dong commune
14	Ngo Xuan Tu	Hai Dong commune
15	Tran Dinh Quy	Hai Dong commune
16	Hoang Van Tri	Hai Dong commune
17	Pham Dinh Son	Hai Dong commune
18	Do Van Nhien	Hai Dong commune
19	Pham Dinh Loi	Hai Dong commune
20	Tran Xuan Luu	Hai Dong commune
21	Vu Thanh Chung	Hai Dong commune
22	Do Van Kinh	Hai Dong commune
23	Nguyen Duc Hien	Hai Chinh commune
24	Huynh Thai Phung	Hai Chinh commune
25	Nguyen Thanh Tuan	Hai Chinh commune

No.	Name	Affiliation
26	Nguyen Van Thao	Hai Thinh commune
27	Tran Van Manh	Hai Trieu commune
28	Doan Thi Lan	Hai Trieu commune
29	Vu Van Tuan	Hai Trieu commune
30	Do Quoc Vuong	Hai Trieu commune
31	Vu Viet Van	Hai Ly commune
32	Vu Ngoc Dinh	Hai Ly commune
33	Hoang Truong Giang	Hai Ly commune
34	Nguyen Viet Phan	Hai Ly commune
35	Vu Viet Ly	Hai Ly commune
36	Le Manh Duong	Thinh Long commune
37	Le Cong San	Thinh Long commune
38	Tran Van Ha	Thinh Long commune
39	Pham Ngoc Tu	Thinh Long commune
40	Pham Van Tru	Thinh Long commune
41	Mai Hong Le	Hai Trieu commune
42	Bui Van Dung	Hai Trieu commune
43	Bui Cong Tien	Hai Trieu commune
44	Pham Viet Ha	Hai Dong commune
45	Pham Duc Long	Hai Dong commune
46	Do Duc Loi	Hai Dong commune
47	Pham Van Phung	Hai Hòa commune
48	Nguyen Van Bac	Hai Hòa commune
49	Nguyen Van Nang	Hai Hòa commune

5. The Objective and Technical Program:

Objective: The main objective of this Workshop is to help the local government understand and gather knowledge on the impactions of geohazard in Vietnam coastal zone and especially focus the geohazard of sea dike erosion and flooding in Hai Hau place. The presentations also suggest the solutions on measures of non-structures and structure that should be applied in Hai Hau to mitigate the damage due to those hazard risks. The presentation that mentioned to the 4 local guidelines as (i) local manager; (ii) local combat forces; (iii) local means and material; (iv) local logistics was interested to both the local governments and local community. During the workshop, the science professional and the participants had opened discussion, the questions and problems given by local community will help the science to collect more information and do more successfully the project activities.

Technical Program

Morning Saturday, 18 September 2010: Workshop in Hai Dong commune	
8h30– 9h00	Registration
9h00 – 9h15	Opening ceremony - Assoc. Prof. Dr. Sc. Nguyen Manh Lieu, Director, Civil Engineering Board, Vietnam National University, Hanoi with his speech - Mr. Tran Van Chinh, Vice- President of Hai Hau District People's committee with his speech
9h15 –10h00	Assoc. Prof. Dr. Chu Van Ngoi: The Impactions of Climate Change to Environment, Economics and Society in the Coastal zone
10h00 – 10h45	Assoc. Prof. Dr. Sc. Vu Cao Minh: The Structure Solutions for Improvement the Stability of Sea Dike System to Respond in Climate Change
10h45– 11h30	Assoc. Prof. Dr. Do Minh Duc: The Modeling of Community Based to Mitigate the Hazard Risks related to Climate Change
Afternoon, Thurdays, 18 September 2010: Field trip along Hai Hau coastal area	

6. Photographs

Fig 1. The participants attended on the Workshop

Fig 2. Assoc. Prof. Dr. Sc. Tran Manh Lieu, Director, Civil Engineering Board, Vietnam National University, Hanoi with his welcome speech

Fig 3. Mr. Tran Van Chinh, Vice- President of Hai Hau District People's committee with his welcome speech

Fig 4. Assoc. Prof. Chu Van Ngoi was presenting his presentation

Fig 5. Assoc. Prof. Dr. Sc. Vu Cao Minh was presenting his presentation

Fig 6. Assoc. Prof. Dr. Do Minh Duc was presenting his presentation

Fig 7. Mr. Tran Van Chinh discussed the local problem and shared the experience to the scientists

Fig 8. The group photo with the representative local government and some participants

Fig 9. One of the church that is sea site (out of current dike) need to protect to become the ancient evidence showing the damage of storms in this area

Fig 10. The science experts discussed with the local community on the erosion of sea dike

Short report of the Workshop on Wednesday 2010-09-22 and Thursday 2010-09-23

MITIGATION OF HAZARD RISK IN RESPONSE TO CLIMATE CHANGE

The Department of Geotechnics, Hanoi University of Science with the supporting from The Project of CIA2009-06-Duc, in cooperation with the University of Bonn Department of Geography and UNITED NATIONS UNIVERSITY Institute for Environment and Human Security organize a workshop on Mitigation of hazard risk in response to climate change for selected Master and Ph.D. students.

1. Date: Wednesday 2010-09-22 – Thursday 2010-09-23

2. Venue: Room 416, T1 Building, Hanoi University of Science, VNU, Hanoi

334 Nguyen Trai, Thanh Xuan, Hanoi

3. Organization Board:

No.	Full name	Title	Affiliation
1	Nguyen Hoang Luong	Prof. Dr. Sc.	Vice-Rector of Hanoi University of Science, Vietnam National University, Hanoi (HUS, VNU, Hanoi)
2	Do Minh Duc	Assoc. Prof. Dr.	Deputy-Dean, Faculty of Geology, HUS, VNU, Hanoi
3	Duong Thi Toan	MSc.	Faculty of Geology, HUS, VNU, Hanoi
4	Dr. Jörn Birkmann	Dr.	University of Bonn

4. The Participants

The participants invited by HUS to the Workshop

No.	Full name	Title	Affiliations
1	Nguyen Hoang Luong	Prof. Dr.	Vice- Rector , HUS
2	Do Minh Duc	Assoc. Prof. Dr.	Deputy-Dean, Faculty of Geology, HUS, VNU, Hanoi
3	Tran Thi Hong	Assoc. Prof. Dr.	Head of Department of Science and Technology, HUS
4	Pham Thuy Loan	Dr.	Deputy Director, Urban and Architectural Institute, National University of Civil Engineering
5	Nguyen Quang	Dr.	UN-HABITAT Vietnam
6	Duong Anh Tuyen	Dr.	Vietnam Human Resource Development Department
7	Bach Tan Sinh	Mr.	National Institute for S&T Policy and Strategic Studies
8	Dang Hoang Ha	Mr.	Center for water resources Planning and Investigation
9	Vu Cao Minh	Assoc. Prof. Dr.Sc.	Head, Department of Geotechnics, Faculty of Geology, HUS, VNU, Hanoi
10	Chu Van Ngoi	Assoc. Prof. Dr.	Faculty of Geology, HUS, VNU, Hanoi

11	Dang Van Luyen	MSc.	Faculty of Geology, HUS, VNU, Hanoi
12	Dinh Van Thuan	Mr.	Institute of Geology
13	Ta Trong Thang	Assoc. Prof.	Faculty of Geology, HUS
14	Hoang Minh Hien	Dr.	Ministry of Agriculture an Rural Development
15	Nguyen Ngoc Thach	Assoc. Prof.	Faculty of Geography, HUS
16	Nguyen Thi Hong	Ms.	Faculty of Geology, HUS
17	Doan Dinh Lam	Dr.	Institute of Geology
18	Vu Van Tich	Dr.	Vice-Dean, Faculty of Geology, HUS
19	Nguyen Van Vuong	Assoc. Prof.	Dean, Faculty of Geology, HUS
20	Tran Canh	Assoc. Prof.	Institute of Geology
21	Doan Van Tuyen	Dr.	Institute of Geology
22	Cao Vinh Hai	Dr.	Center Resources and Reduce Rural Poverty
23	Du Van Toan	Dr.	Vietnam Administration of Seas and Islands Ministry of Natural Resources and Environment (MONRE).
24	Dang Quang Khang	Mr.	Faculty of Geology, HUS, VNU, Hanoi

The participants came from University of Bonn, Germany

No.	Full name	Nationality	Title
1	Dr. Birkmann, Jörn	German	Academic Officer. Head, Vulnerability Assessment, Risk Management & Adaptive Planning Section
2	Vu Anh Tuan	Vietnamese.	PhD student
3	Henneberger, Andrea Heidi	German	Master student
4	Antonj, Carmen	German	Master student
5	Backes, Cristina	German	Master student
6	Bednarek, Nathalie Ines	German	Master student
7	Dohr, Michael	German	Master student
8	Gorus, Natalie	German	Master student
9	Joksch, Christian	German	Master student
10	Karstens, Svenja	German	Master student
11	Kissling, Anne Christine	German	Master student
12	Krummenauer, Linda	German	Master student
13	Kukula, Dominik Johann	German	Master student
14	Kurtenbach, Tobias	German	Master student
15	Lehr, Dorit Verena	German	Master student
16	Meiser, Annika	German	Master student
17	Michelis, Jonas Orlando	German	Master student
18	Ogasa, Dominika	German	Master student
19	Schormueller Anne Kathrin	German	Master student
20	Stiebens, Anna Christina	German	Master student
21	van Laak, Michael	German	Master student
22	Welle, Jan Henrik	German	Master student
23	Yang, Xiaowei	Chinese	Master student

5. The Objective and Technical Program:

The workshop aims on the one hand at bringing together young scientists from Germany and Vietnam to foster international exchange with regard to climate change. On the other hand, the invitation of

selected experts should enable a learning environment and give the participants the opportunity to profit from the different fields of expertise of the invited speakers.

Technical Program

Date	Topics
	Wednesday (22th Sep.)
08:30 - 09:00	**Registration**
09:00 - 09:10	**Opening Speech and Round of Introduction** - Introduction all participants - Welcome speech from Hanoi University of Science - Speech from Bonn University
Chairman: Dr. Jörn Birkmann	
09:10- 09:40	**Trends in Urbanization in Vietnam and Hanoi** Mr. Xiaowei Yang
09:40 - 10:00	**Water related Urban Planning : A case of Hanoi city** Dr. Pham Thuy Loan, Deputy Director, Urban and Architectural Institute, National University of Civil Engineering
10:00 – 10:20	**Urban Development and Climate Change Adaptation in Vietnam** Dr. Nguyen Quang / UN-HABITAT Vietnam
10:20 – 10:30 Tea break	
Chairman: Assoc. Prof. Do Minh Duc	
10:30 - 10:50	**Adaptation strategies and measures to increasing flood risks and climate change** Ms. Andrea Henneberger
10:50 - 11:10	**Using Remote sensing and GIS techniques for study desertification in Viet Nam** Assoc. Prof. Dr. Nguyen Ngoc Thach, HUS
11:10 - 11:30	**The change of soil properties due to sea water impaction in the Red River Delta of Vietnam** Ms. Duong Thi Toan, HUS
11: 30 – 13:30 Lunch Break	
Chairman: Prof. Tran Nghi	

13:30 - 13:50	**Cities Adapting to Climate Change – Rockefeller Foundation Projects** Mr. Bach Tan Sinh / National Institute for S&T Policy and Strategic Studies
13:50 -14:10	**Sea Level Rise and Environmental Impacts in the Mekong River Delta** Prof. Dr. Tran Nghi, HUS
14:10 - 14:30	**Flooding and Mountainous River Bank Erosion: A Case Study of Cau River, Bac Kan Province** Assoc. Prof. Dr. Do Minh Duc, HUS
14:30 - 14:50	**Flood protection along the River Rhine in Germany Rhine as comparison (urbanization, history of change, industry)** Dr. Jörn Birkmann / Uni Bonn /UNU-EHS
14:50 – 15:00 Tea Break	
Chairman: Dr. Vu Van Tich	
15:00 – 15:30	**Climate Change Adaptation Challenges in Vietnam** Dr. Koos Nefjes / Special Advisor of UNDP to the Government of Vietnam
15:30 – 16:00	**Flood protection along the Red River Hanoi** Mr. Christian Joksch and Mr. Jonas Michelis
16:00– 16:30	**Statement and Discussion of the key challenges for climate change adaptation in Vietnam** Mr. Michael van Laak
16:30	**Closing Workshop ceremony**
Thursday (23rd Sep.) **Core-members only**	
07:30 - 16:30	**Boat trip along Red River** **(Lunch at a restaurant on the way)**
16:30 – 17:00	Reflection of the boat trip and the city tour – discussion of some impressions and findings.

6. Photographs

Workshop on Wednesday 2010-09-22

Fig. 1. Assoc. Prof. Dr. Do Minh Duc was presenting his presentation

Fig. 2. Dr. Bach Tan Sinh was presenting his presentation

Fig. 3. Prof. Dr. Tran Nghi was presenting his presentation

Fig. 4. Ms. Andrea Henneberger was presenting her presentation

Pictures of fieldwork on Thursday 2010-09-23 along the Red River in Hanoi

Fig 5. Discussion between young research Vietnam and Bonn on the boat

Fig 8. Group photo of students

List of young scientists attended activities of the project

CAPACITY DEVELOPMENT FOR ADAPTATION TO CLIMATE CHANGE IN THE RURAL COASTAL ZONE OF VIETNAM

No.	Last Name	Title	Organization
1	Nguyen Thi Minh Thuyet	Dr.	Faculty of Geology, Hanoi University of Science (HUS)
2	Dang Quang Khang	Mr.	Faculty of Geology, HUS
3	Duong Thi Toan	MSc.	Faculty of Geology, HUS
4	Nguyen Dinh Nguyen	Mr.	Faculty of Geology, HUS
5	Nguyen Thi Ha	Ms.	Faculty of Environment, HUS
6	Tran Dang Quy	Mr.	Faculty of Geology, HUS
7	Nguyen Thi Hong	Ms.	Faculty of Geology, HUS
8	Tran Van Tuy	Mr.	Faculty of Environment, HUS
9	Dinh Xuan Thanh	Mr.	Faculty of Geology, HUS
10	Hoang Minh Thao	Dr.	Faculty of Geology, HUS
11	Nguyen Hieu	Dr.	Faculty of Geography, HUS
12	Nguyen Thuy Linh	Ms.	Faculty of Geology, HUS
13	Ha The Dinh	Mr.	Hanoi Water Resource Trace Institute
14	Le Thi Mai	Ms.	Hanoi Water Resource Trace Institute
15	Bui Thi Tuyet	Ms.	Center of Environment Education and Communicate
16	Dang Hoang Ha	Mr.	Center for water resources Planning and Investigation
17	Do Thi Nhinh	Ms	Institute of Geography
18	Nguyen Hong Quang	Mr.	Institute of Science on Geology and Mineral
19	Nguyen Thi Vinh Ha	Ms.	College of Economics, Vietnam National University, Hanoi
20	Nguyen Thi Thanh Hang	Ms.	Hanoi Water Resource Trace Institute
21	Nguyen Thi Kim Cuc	Ms.	Hanoi Water Resource University

Among the above mentioned list, 3 first people are core members of the project who have joined all activities of the project since the beginning.

In addition, the project made a good chance for young master students from the University of Bonn, Germany to present and exchange the ideas on climate change, especially on hazard mitigation. Although the time is short they could meet and learn from experts of Vietnam. They could also have initial comparison between a developed and developing country.

The young participants from the University of Bonn, Germany

No.	Full name	Nationality	Title
1	Vu Anh Tuan	Vietnamese	PhD student
2	Henneberger, Andrea Heidi	German	Master student
3	Antonj, Carmen	German	Master student
4	Backes, Cristina	German	Master student
5	Bednarek, Nathalie Ines	German	Master student
6	Dohr, Michael	German	Master student
7	Gorus, Natalie	German	Master student
8	Joksch, Christian	German	Master student
9	Karstens, Svenja	German	Master student
10	Kissling, Anne Christine	German	Master student
11	Krummenauer, Linda	German	Master student
12	Kukula, Dominik Johann	German	Master student
13	Kurtenbach, Tobias	German	Master student
14	Lehr, Dorit Verena	German	Master student
15	Meiser, Annika	German	Master student
16	Michelis, Jonas Orlando	German	Master student
17	Ogasa, Dominika	German	Master student
18	Schormueller, Anne Kathrin	German	Master student
19	Stiebens, Anna Christina	German	Master student
20	van Laak, Michael	German	Master student
21	Welle, Jan Henrik	German	Master student
22	Yang, Xiaowei	Chinese	Master student