International Workshop on

Higher Education in Adapting to Climate and Ecosystems Change

Co-organized by UNU-ISP, VNU and IR3S

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Edited by

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PREFACE

The international workshop on *Higher Education in Adapting to Climate and Ecosystems* is the second workshop of the University Network for Climate and Ecosystems Adaptation Research (UN-CECAR). The workshop is organized to exchange information on climate change adaptation research in Viet Nam and to discuss concrete action plan for the realization of the objectives of the UN-CECAR. For the first component, we have invited 5 leading research institutions in Viet Nam to present on going research related to climate change and adaptation issues. This meeting is a part of a new UNU research project on climate change adaptation impacts. The project addresses the question *what are the impacts of adaptation to climate change?* We are all very much concerned with how climate change will affect us. In order to understand this, we look at projected climate change scenarios, downscale them to local conditions, and assess impacts on various sectors under predicted future weather conditions. Then we propose adaptation strategies to overcome or mitigate adverse impacts. We also recognize that there could be many feasible strategies that can be used for adaptation.

Some of these proposed adaptation strategies may also lead to conflicts or create negative impacts in some other sectors. For example a policy to subsidize fertilizer to increase yield could have negative impacts on policies on organic farming, water quality improvements and health. To avoid *mal-adaptaiton* we need to assess impacts of adaptation; especially with reference to development planning. This is the topic of the new research project. Initially UNU-ISP will organize research in 4 countries in water and rice production sectors. The countries are Philippines, Sri Lanka, Thailand and Viet Nam. Through these studies, it is hoped to develop frameworks for designing adaptation strategies; by looking beyond adaptation. The project is supported by the Mitsui foundation of Japan. We are very much thankful to the 5 Universities for kindly accepting our invitations and presenting extremely interesting and thought provoking studies.

The second component consist of a half-a-day international conference of UN-CECAR where experiences of IR3S, Korea and Indonesia are presented from different perspectives, and a full one day program deliberating and planning way forward. For the discussions, two working groups have been formed; one for Research and one for Education programs, and with the help of 2 co-chairs each, the groups discussed and proposed concrete measures for implementation in the coming few months.

After the completion of the workshop in June, 2009, in Tokyo, the International Coordinating Committee (ICC) members have discussed the terms of reference for the network UN-CECAR and the items to be discussed in Viet Nam. We are thankful to all the ICC members for providing information on relevant research at each institute and existing educational programs as well as other relevant initiatives which formed the background materials for the meeting.

Finally we would like to take this opportunity to thank the Viet Nam National University, in particular to its President Prof. Nhuan and Acting Director of International Relations Department, Dr. Nguyen Anh Thu, and their staff for the excellent arrangements and coordination that made this workshop possible. Our appreciation also goes to Ms. Yuriko Aoyanagi, Ms. Hiroko Nakazawa, Mr. Hideyuki Konishi and Ms. Alva Lim of UNU-ISP for their valuable support in organizing this event.

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FOREWORD

The *University Network on Climate and Ecosystems Change Adaptation Research* is a very important topic for us at the UNU Institute for Sustainability and Peace, in which I serve as the director. This institute was established in January, 2009 by combining the Environment and Sustainable Development program and the Peace and Governance program of UNU center in Tokyo. The new institute is composed of three sections, namely; Global Change and Sustainability, Peace and Security and International Cooperation and Development. Adapting to climate change is a topic that is directly related to all the sections of UNU-ISP and is one of the major cross cutting themes we address.

Following the IPCC Assessment Report 4 there is a wide consensus now that climate change is indeed occurring and it is mainly caused by human activities producing GHG emissions. Consequently, adaptation to climate change has emerged as one of the most important concerns in global development agenda. This is because of the realization that even with effective mitigation actions across the globe, already existing GHG in atmosphere will lead to significant changes in future climate.

Another landmark assessment of global sustainability was the Millennium eco-systems assessment. This global assessment identified that a vast majority of global eco-systems are threatened due to resource exploitation and human activities. Ecosystem services are crucial for our livelihoods and wellbeing. We take them for granted, and realize their importance only when the eco-systems can no longer provide these services. Often it is too late by then. Now we have an added dimension of climate change, which may threaten fragile eco-systems. It is therefore, important to take in to account inter-linkages among society and eco-systems when seeking sustainable solutions to climate change.

Adaptation was identified as one of the five key building blocks required for a strengthened future response to climate change during the thirteenth session of the Conference of the Parties (COP 13) in Bali. In COP14 in Poznan, the needs for successful adaptation were discussed at length. This discussion on implementing adaptation strategies has led to the broad recognition that what is needed in adaptation is not much different from development planning. The only pragmatic way to approach adaptation is by incorporating climate change resilience in to development planning. The need for local capacity development is a pre-requisite to effectively utilize global support for adaptation efforts.

The 10th Conference of the Parties to the Convention on Biological Diversity, COP 10, will be held in October 2010, in Aichi, Nagoya, Japan. The major emphasis of the conference is the *Development of Local Action Plan*. It is envisaged that such local actions plans developed in consideration to the three pillars; enhancing coexistence with nature in the region; enhancing sustainable utilization of living resources in industrial development and lifestyles; and enhancing wide-ranging relations leading to low-carbon, recycling-type sustainable society that coexists with nature.

From all this, it is clear that *Local Action* is the key concept towards developing a sustainable future for the world with resilience in both nature and society to face the challenge of climate change. Developing local capacity through the leadership of higher education is essential to customize and make use of accumulated knowledge and technologies that are available globally, in the local context.

United Nations University Institute for Sustainability and Peace (UNU-ISP) and the Integrated Research System for Sustainability Science (IR3S) of Tokyo University organized a conference and 2-day workshop to discuss the *Role of Higher Education in Adapting to Climate Change* at UNU Headquarters from June 10-12. Presidents, deans and heads of the departments from 12 leading universities in Asia-PaciÞc and 4 universities in Japan, together with 5 international organizations participated in the conference and workshop. Following the events, the participants agreed to establish a *University Network for Climate Change and Ecosystems Adaptation Research (UN-CECAR)*. UN-CECAR will provide the platform through which participating universities will collaborate and create comprehensive international postgraduate programmes that produce the necessary human resources and research needed to adapt to climate change. It will also improve multidisciplinary communication across educational institutions in Asia. The two day workshop we organize in Viet Nam with the *National University of Viet Nam* will help us to identify the key elements and design practical action plans in achieving the UN-CECAR objectives.

The whole world has come together as never before to tackle the climate change challenge. It provides us with a golden opportunity to design development strategies not only for reducing adverse climate change impacts, but to go beyond adaptation, towards a truly sustainable global future. I hope the tasks we identified among the leading universities of Asian region gathered here today, will provide leadership to address the adaptation and development issues in a truly comprehensive and holistic manner.

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INTRODUCTION

Climate change presents unprecedented multidimensional and transboundary challenges, particularly for all countries and communities in the Asia Pacific region. Home to a variety of geography, topography, biodiversity and climate, as well as systems of social governance and economies, the region will be affected by climate change in many different ways requiring a myriad of adaptation strategies to ensure sustainable development.

How we adapt and the solutions we create to overcome the adverse impacts of climate change, must evolve locally, while being supported by regional and global knowledge and experiences. Adaptation strategies must evolve locally incorporating the diverse and complex interactions of all affected stakeholders as well as local ecology, processes and socio-economic characteristics. For adaptation strategies to evolve locally, local human resources and technical capacities should be developed, particularly in the most vulnerable regions of the world. This must be achieved through a range of learning processes, of which postgraduate education will play a key role, and where the necessary research can be conducted in partnership with implementing agencies and local communities.

Higher educational institutions in the Asia Pacific can be at the forefront of world-class research on climate change adaptation. However, wide disparities exist within the region as well as within countries, with significant variations in the level and type of research knowledge, financial and technological resources available among institutions. Moreover, research currently in progress tends to be scattered across separate programs and locations.

Taking up this challenge, leading universities in the Asia-Pacific region have agreed to establish the University Network for Climate and Ecosystems Change Adaptation Research (UN-CECAR). Research and education will be the main focus of the network that will bring together all-available resources and expertise across disciplinary lines to work collaboratively to enhance understanding on how climate change is affecting roughly two-thirds of the world's population and advance adaptation research for the design of appropriate policy and development strategies.

HISTORY

This initiative is an outcome of the conference on 'The Role of Higher Education in Adapting to Climate Change' held during 10-12 June 2009 at United Nations University headquarters, Tokyo, Japan. The first of its kind in the region, the aim of the three-day event was to put higher education on top of the climate change adaptation agenda. Presidents, deans and heads of departments from leading universities in the region not only discussed and shared information on existing climate-related teaching and research, but also dedicated to brainstorming innovative

ideas for a regional curricula, joint research projects and resource sharing, as well as future action plans. The event successfully established a regional network that will provide the foundations for a comprehensive postgraduate educational program to produce the necessary students, educators, and research needed for effective adaptation to climate change. Representatives from more than 18 universities and research organizations from across the Asia-Pacific, as well as international and intergovernmental organizations attended. The conclusion of the event was a commitment to further develop this initiative and this workshop marks the first to be followed by Indonesia (March, 2010). UNU and IR3S is also planning to establish a similar initiative in Africa, beginning with a conference in Ghana (October, 2009).

PARTICIPATING UNIVERSITIES

In the June Tokyo Conference, the participants agreed to establish an institutional platform of universities and partner research institutions to further climate change adaptation agenda in higher education sector. Representatives from the following leading universities and research institutions from Asia-Oceania Region took part in the workshop during 23-23 August 2009.

1. National University of Viet Nam, Viet Nam (Co-host)
2. Faculty of Engineering, Gadjah Mada University, Indonesia
3. Climate Change Institute, Australian National University, Australia
4. Institute of Forest Ecology, Environment and Protection, Chinese Academy of Forestry, China
5. Institute of Hydrology and Water Resources, Tsinghua University, China
6. Faculty of Engineering, University of Peradeniya, Sri Lanka
7. Institute for Environment and Development (LESTARI), Universiti Kebangsaan, Malaysia
8. Center for Atmospheric Science, Indian Institute of Technology, Delhi, India
9. Yeungnam University, Korea
10. Department of Civil Engineering, Institute of Engineering, Nepal
11. National Hydraulic Research Center, University of the Philippines
12. Department of Civil Engineering, Bangladesh University of Engineering and Technology, Bangladesh
13. Graduate Program on Sustainability Science/IR3S, University of Tokyo, Japan
14. Institute of Sustainability and Peace, United Nations University (Co-host)

Absentees for the meeting

1. Asian Institute of Technology, Thailand
2. Center for Water Environment Studies, Ibaraki University, Japan
3. Disaster Prevention Research Institute, Kyoto University, Japan
4. Graduate School of Asia-Pacific Studies, Waseda University, Japan
5. Ritsumeikan Asia Pacific University, Japan
6. Faculty of Policy Management, Research Director, Global Security Research Institute, Keio University, Japan
7. Learning to Live with Climate Change Programme, Open University, UK
8. Department of Civil Engineering, University of Tokyo, Japan

2 PRESENTATIONS

DEVELOPMENT OF CLIMATE CHANGE SCENARIOS FOR VIET NAM

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Introduction

According to the Inter-governmental Panel on Climate Change (IPCC), a climate change scenario is a plausible description of future climate, based on a set of climatic relations, being developed to be used in studies of the consequences of climate change induced by anthropogenic activities and often used as inputs for impact assessments. The IPCC's results are presented in the first assessment report in 1992 through the fourth assessment report in 2007.

At present, many regions and countries have developed climate change scenarios at regional, national, and climatic or smaller scales. Most climate change scenarios are constructed for the time frame of decades of the 21stcentury.

In Vietnam, there is a number of climate change scenarios developed and applied for different purposes of climate change related activities. However, in order to have more comprehensively scientific and practical based scenarios for the implementation of NTP, the Government has assigned MONRE to be a coordinating agency for developing climate change scenarios, especially sea level rise for Vietnam.

The scenarios of climate change, sea level rise for Vietnam presented in this report were developed based on the available national and international studies, the comments and ideas of experts and managers of relevant ministries and sectors. These scenarios will be updated and improved on schedule at 2010 and 2015. According to these scenarios, climate may significantly change over all regions of Vietnam. At the end of the 21st century, the average temperature in Vietnam is expected to increase about 2.3^{o}C; the total annual rainfall and the rainy season's rainfall would increase while the dry season's rainfall would decrease; the sea level is expected to rise about 75 cm compared to the average for 1980 - 1999.

Climate change, sea level rise in Viet Nam

Climate change, illustrated mainly by global warming and sea level rise, is mainly caused by human activities that emit excessive greenhouse gas into the atmosphere.

According to the IPCC 4th assessment report in 2007, the global average temperature has risen about 0.74^{o}C in the period of 1906 - 2005

and the rate of change in recent 50 years is nearly double of that in the former 50 years. Temperatures rise on the continents are faster than in the oceans [1].

In the past 100 years, rainfalls tend to increase in the area with latitude higher than 30^{o} but decrease in tropical areas since the mid 1970s. Heavy rainfall events are increasing in many regions of the world.

Global sea level rises in the 20^{th} century with an increasing rate. Two main causes of sea level rise are thermal expansion and ice melting.

In Vietnam, observed data show that changes of climate factors and sea level have the following noticeable feature:

TEMPERATURE: During the last fifty years (1951 - 2000), annual average temperature in Vietnam increased by 0.5 to 0.7^{o}C. Annual average temperature in the last four decades (from 1961 to 2000) was recorded higher than annual average value of the three previous decades (from 1931 to 1960). Annual average temperature in the period from 1991 to 2000 in Ha Noi, Da Nang and Ho Chi Minh City were 0.8^{o}C; 0.4^{o}C and 0.6^{o}C, respectively, higher than average value in the decade of 1931 and 1940. In 2007, annual average temperature at these three locations were all higher than the average in the 1931 - 1940 decade by 0.8 - 1.3^{o}C and similarly higher than average in the 1991 - 2000 decade by 0.4 - 0.5^{o}C [2].

RAINFALL: At every location, change of annual average rainfall in the last 9 decades (1911 - 2000) was not consistent with each other. There was ascending time and also descending time. In the whole country of Vietnam, the trend of rainfall change varies from region to region [2].

COLD FRONTS: In the last two decades, number of cold fronts affecting Vietnam was reduced significantly. Recent climate abnormal is the cold front that caused extreme and damaging cold in 38 consecutive days during January and February 2008. This significantly damaged agricultural production[2].

TYPHOON: In recent years, there were more typhoons with higher intensity affecting Viet Nam. Typhoon track has a tendency of moving towards southern latitude and typhoon season ends later. Many typhoons moved more abnormally [3].

DRIZZLING: Numbers of average drizzle days in Hanoi in the decade of 1981-1990 gradually decreased and in 10 recent years, there was only half of multi-year average number (15 days/year) [4].

SEA LEVEL: Data from tidal gauges along Vietnam coasts show that sea level rise at a rate of about 3mm/year during the period of 1993-2008 which is comparable with global tendency. In the past 50 years, sea level at Hon Dau station rose about 20 cm [2].

Basics for development of climate change, sea level rise in Viet Nam

In the IPCC's study, development of climate change scenarios for the 21^{st} century is the key task conducted by Working Group 1. Scenarios are used by Working Group 2 to assess impacts of climate change, and

to develop climate change adaptation and mitigation measures carried out by Working Group 3.

Climate change depends primarily on socio-economic development, i.e. emission level of greenhouse gases. Therefore, scenarios of climate change scenarios are developed basing on greenhouse gas emission scenarios.

Humans have emitted excessive greenhouse gas to the atmosphere through activities such as industry, agriculture, transportation, deforestation, etc., hence, the basis to greenhouse gas emission scenarios are: (1) Development at global scale; (2) Population and consumption; (3) Income and way of life; (4) Energy consumption and energy recourses; (5) Technology transfer; (6) Land use change.

According to the latest recommendations of the IPCC, the scenarios of gas emission are from low to high: B1, A1T, B2, A1B, A2, and A1FI. However, depending on practical demand and the ability of each nation, IPCC also recommended the selection of gas emission scenarios suitable to develop climate change scenarios.

In the Special Report on Emissions Scenarios [11], IPCC introduces 40 scenarios, reflecting relatively diversified possibilities of greenhouse gas emission in the 21st century. These emission scenarios are combined into 4 groups namely A1, A2, B1, and B2 with the following characteristics:

A1 FAMILY: Rapid economic growth; A global population that reaches nine billions in 2005 in 2005 and then gradually declines; The quick spread of new and efficient technology; A convergent world-income and way of life converge between regions, Extensive social and cultural interactions worldwide. There are subsets to the A1 family based on their technological emphasis:

- A1FI: An emphasis on fossil fuels (high emission scenario);
- A1B: A balanced emphasis on all energy sources (medium emission scenario);
- A1T: Emphasis on non-fossil energy sources (low emission scenario).

A2 FAMILY: A world of independently operation, self-reliant nations; Continuously increasing population; Regionally-oriented economic development; Slower and more fragmented technological changes and improvements to per capita income (high emission scenario, similar to A1FI).

B1 FAMILY: Rapid economic growth as in A1, but with rapid changes toward a service and information economy; Population rising to 9 billion in 2050 and then declining as in A1; Reductions in material intensive and the introduction of clean and resources efficient technologies; An emphasis on global solutions to economics, social and environment stability (low emission scenario, similar to A1T).

B2 FAMILY: Continuously increasing population, but at a slower rate than in A2; Emphasis on local rather than global solutions to economic, social and environmental stability; Intermediate levels of economic development; Less rapid and more fragmented technological changes than in B1 and A1 (medium emission scenario, in the same group of A1B).

Four groups of emission scenarios are recommended by IPCC for the development of climate change scenarios development, arranged from low to high, namely: B1, A1T (low emission scenarios), B2, A1B (medium emission scenarios), and A2, A1FI (high emission scenarios). However, depending on practical requirements and computing capacity, scenarios among these groups can be selected for climate change scenarios development.

Studies in Vietnam and overseas on climate change scenarios are analysed and referred for the development of climate change scenario for Vietnam, as follows:

1. Studies Overseas
    - The 2nd (1995), 3rd (2001), and 4th (2007) IPCC Assessment Reports;
    - Results from the global climate model (MRI-AGCM) with 20 km resolution from the Meteorological Research Institute and Japan Department of Meteorology;
    - Report of climate change scenario for Vietnam by research group of the Oxford University, United Kingdom;
    - Data from TOPEX / POSEIDON and JASON1 satellite since 1993;
    - Recent studies on sea level rise: CSIRO Marine and Atmospheric Research; Proudman Oceanographic Laboratory - Natural Environment Research Council, University of Hawaii Sea Level Center.
    - Sea level rise scenarios in IPCC Assessment Reports in 2001 and 2007;
    - Reports on sea level rise from Tiempo Climate Cyberlibrary.
2. Studies in Viet Nam:
    - Climate change scenario developed in 1994 for report on climate change in Asia, project funded by Asian Development Bank;
    - Climate change scenario developed for the Vietnam National Initial Communication to the UNFCCC [3];
    - Climate change scenario developed by Vietnam Institute of Meteorology, Hydrology and Environment (IMHEN) by applying MAGICC/SCENGEN 4.1 software and statistical downscaling method for Vietnam and other smaller regions [5];
    - Climate change scenario developed by (IMHEN) for the preparation of the Vietnam National Second Communication to the UNFCCC;
    - Climate change scenario developed by (IMHEN) in 2008 by applying MAGICC/SCENGEN 5.3 software and statistical downscaling method [7];
    - Results of study carried out by IMHEN, SEA START and Hadley Centers in 2008 in applying PRECIS model to develop climate change scenario for Vietnam and Southeast Asia region;

- Tidal gauge data along Vietnam coasts;
- Studies on sea water level carried out by Marine Center, General Department of Sea and Island, MONRE;
- Sea level rise scenarios developed by IMHEN for the preparation of the Vietnam National Second Communication to the UNFCCC.

Climate change, sea level rise scenarios for Viet Nam

Criteria for the selection of methods for climate change scenario development include: (1) Credible level of global climate change scenario; (2) Level of details of climate change scenario; (3) Inheritance; (4) Up-to-date; (5) Regional appropriate; (6) Comprehension of scenario; (7) Possibility for Updating.

Based on analysis of the above mentioned criteria, the results calculated by using MAGICC/SCENGEN 5.3 software and statistical downscaling method are selected for the development of climate change scenarios, sea level rise for Vietnam.

Climate Change Scenarios

Greenhouse gas emission scenarios selected for climate change scenarios development are: Low scenario (B1), Intermediate scenario of the medium scenario group (B2), and intermediate scenario of the high scenario group (A2).

Climate change scenarios for temperature and rainfall are computed for seven climatic regions in Vietnam: North West, North East, North delta, North Central, South Central, Central Highlands, and South. The baseline period is 1980-1999 (the same as used in the 4th IPCC Assessment Report).

Climate change scenarios for climatic regions of Vietnam in the 21^{s}t century can be summarized as follows:

TEMPERATURE Temperatures in winter increase faster compared to that in summer for all climatic regions. Temperatures in the northern climatic regions increase faster than in the southern climatic regions.

- According to low scenario (B1): By the end of the 21st century, annual mean temperature in the northern climatic regions can increase about 1.6 to 1.9^{o}C relative to the baseline period (1980 - 1999). Change in temperature in the Southern climatic regions is about 1.1 to 1.4^{o}C.
- According to medium scenario (B2): By the end of the 21st century, annual mean temperature may increase about 2,6^{o}C in the North West, 2,5^{o}C in the East West, 2,4^{o}C in the North Delta, 2,8^{o}C in the North Central, 1,9^{o}C in the South Central, 1,6^{o}C in the Central Highlands, and 2,0^{o}C in the South relative to the baseline period of 1980 - 1999 (Table 1).
- According to high scenario (A2): By the end of the 21st century, annual mean temperature in the northern climatic region can increase about 3.1 to 3.6^{o}C relative to the baseline period (1980

Climatic Region	Decades in the 21 Century								
	2002	2003	2004	2005	2006	2007	2008	2009	2010
North West	0.5	0.7	1.0	1.3	1.6	1.9	2.1	2.4	2.6
North East	0.5	0.7	1.0	1.2	1.6	1.8	2.1	2.3	2.5
North Delta	0.5	0.7	0.9	1.2	1.5	1.8	2.0	2.2	2.4
North Central	0.5	0.8	1.1	1.5	1.8	2.1	2.4	2.6	2.8
South Central	0.4	0.5	0.7	0.9	1.2	1.4	1.6	1.8	1.9
Central Highlands	0.3	0.5	0.6	0.8	1.0	1.2	1.4	1.5	1.6
South	0.4	0.6	0.8	1.0	1.3	1.6	1.8	1.9	2.0

Table 1: Changes in Annual Mean Temperature (^{o}C) Relative to period of 1980-1999, Medium Scenario (B2)

- 1999), in which, North West region: 3.3^{o}C, North East region: 3.2^{o}C, North Delta region: 3.1^{o}C, and North Central region: 3.6^{o}C. Change in temperature in the Southern climatic regions is 2.4^{o}C in South Central, 2.1^{o}C in the Central Highlands, and 2.6^{o}C in the South.

RAINFALL Rainfall in dry season may decrease in most climatic regions, especially the southern climate regions. Rainfall in rainy season and annual rainfall may slightly increase in all climatic regions.

- According to low scenario (B1): By the end of the 21st century, rainfall may increase, relative to the period of 1980 - 1999, about 5% in the North West, North East, North Delta, and North Central regions, and about 1 - 2 % in the South Central, Central Highlands and South regions. Rainfall in the period from March to May may decrease about 3-6% in the North; rainfall in the middle of the dry season in the South may decrease up to 7-10%. Rainfall in the middle of the rainy season may increase 6 to 10% for the four climatic regions of the North and the South Central, and it is about 1% in the Central Highlands.

- According to medium scenario (B2): By the end of the 21st century, rainfall may increase, relative to the period of 1980 - 1999, about 7-8% in the North West, North East, North Delta, and North Central regions, and about 2 - 3 % in the South Central, Central Highlands and South regions. Rainfall in the period from March to May may decrease about 4-7% in the North West, North East, North Delta; and about 10% in the North Central. Rainfall in the middle of the dry season in the South may decrease up to 10-15%. Rainfall in the middle of the rainy season may increase 10 to 15% for the four climatic regions of the North and the South Central, and it is about 1% in the Central Highlands (Table 2).

- According to high scenario (A2): By the end of the 21st century, rainfall may increase, relative to the period of 1980 - 1999, about

Climatic Region	Decades in the 21 Century								
	2002	2003	2004	2005	2006	2007	2008	2009	2010
North West	1.4	2.1	3.0	3.8	4.6	5.4	6.1	6.7	7.4
North East	1.4	2.1	3.0	3.8	4.7	5.4	6.1	6.8	7.3
North Delta	1.6	2.3	3.2	4.1	5.0	5.9	6.6	7.3	7.9
North Central	1.5	2.2	3.1	4.0	4.9	5.7	6.4	7.1	7.7
South Central	0.7	1.0	1.3	1.7	2.1	2.4	2.7	3.0	3.2
Central Highlands	0.3	0.4	0.5	0.7	0.9	1.0	1.2	1.3	1.4
South	0.3	0.4	0.6	0.8	1.0	1.1	1.2	1.4	1.5

Table 2: Changes in Annual Rainfall (%) Relative to period of 1980-1999, Medium Scenario (B2)

9 - 10% in the North West region, the North East region; 10% in the North Delta region and the North Central region; 4 - 5 % in the South Central region, 2% in the Central Highlands and the South. Rainfall in the period from March to May may decrease about 6-9% in the North West, 13% in the North Central; rainfall in the middle of the dry season in the South Central and Central Highlands may decrease up to 13-22%. Rainfall in the middle of the rainy season can increase 12 to 19% for the four climatic regions of the North and the South Central, and it is about 1-2% in the Central Highlands.

Sea Level Rise Scenarios

The Fourth Assessment Report of IPCC estimated that sea level may rise about 0.26 - 0.59m by 2100.

Studies show that IPCC projection on temperature rise is in good agreement with measured data. However, IPCC projection on sea level rise is underestimated compared to measured data at gauging station and data observed by satellites. The reason is that not all factors were included in these projections (most notably uncertainty surround how ice sheets would react to rising temperatures and interact with oceans) and are consequently too low. Recent studies show that sea leave may rise up to 0,5 - 1,4m by 2100.

Sea level rise scenarios for Viet Nam are computed basing on low (B1), medium (B2), and high (A1FI) emission scenarios.

The results show that, by mid 21st century, sea level may rise 28 to 33cm, and by 2100 sea level may rise about 64 to 100cm relative to the baseline period of 1980 - 1999 (Table 3).

Basing on sea level scenarios, inundation maps are constructed for the Red River delta, Mekong River delta, and other provinces/cities along the coastline, i.e. Quang Ninh, Thanh Hoa, Nghe An, Ha Tinh, Quang Binh, Quang Tri, Thua Thien - Hue, Da Nang, Quang Nam, Quang Ngai, Binh Dinh, Phu Yen, Khanh Hoa, Ninh Thuan, Binh Thuan, Ba Ria - Vung Tau, Dong Nai, and Ho Chi Minh city.

Sea Level Rise Scenario	Decades in the 21 Century								
	2002	2003	2004	2005	2006	2007	2008	2009	2010
Low emission Scenario (B1)	11	17	23	28	35	42	50	57	65
Medium emission Scenario (B2)	12	17	23	30	37	46	54	64	75
High emission Scenario (A1FI)	12	17	24	33	44	57	71	86	100

Table 3: Sea Level Rise (cm) Relative to Period of 1980 - 1999

The inundation maps are constructed based only on topographic maps, other aspects such as effects of tide, wave, storm surge, flow from rivers and other dynamic effects are not yet considered.

Conclusion

Climate change, sea level rise scenarios for Vietnam are developed basing on different emission scenarios, namely, low (B1), medium (B2) and high (A2, A1FI).

The low scenarios (B1) describes the world with low emission: rapid changes toward a service and information economy, low population growth, reductions in material intensive and the introduction of clean and resources efficient technologies; an emphasis on global solutions to economics, social and environment stability. However, with a current convergent world economy, different views between the developed and developing countries, difficulties in international negotiation in limiting temperature change to 2^oC, the low emission scenario does not seem to be possible for the 21^{st} century.

The high scenarios (A2, A1FI) describes the world with high emission, independently operation, self-reliant nations; Continuously increasing population, Regionally-oriented economic development, slower and more fragmented technological changes and improvements to per capita income (A2); or extensive use of fossil fuels (A1FI). These are the worst scenarios that we can imagine. With the development of new and climate friendly technology, affords in international negotiation in greenhouse gas reduction, the world's campaign in "combating climate change", we can hope that the high scenarios will not happen.

Moreover, there are uncertainties in construction socio-economic development scenarios, hence greenhouse gas emission in the future. Apparently, when there are uncertainties, then climate change and sea level rise scenarios that lie in the upper or lower limits have a lower level of confidence that that of the medium one.

Due to the complexity of climate change and limitation of our knowledge in climate, both in Vietnam and in the world, together with

the consideration of mentality, economy, uncertainty in green house gas emission, the medium scenario is, therefore, harmonious and recommended for climate change impacts assessment and action plan development.

It is noted that the results still contain uncertainties due to: (i) Low level of affirmation of emission scenarios; (ii) Certain error of model in simulating for a very long period; (iii) Certain error in the downscaling method basing on the global and regional results; (iv) Uneven distribution of climatic factors in space.

In order to overcome the above mentioned uncertainties, IPCC recommended applying tolerance for climate change scenarios. For example, a tolerance for temperature by the end of 21^{st} century is about 0.4 – 0.6^{o}C, for annual rainfall is 1 - 2% and about 5% for monthly rainfall. Moreover, the scenarios must be frequently updated in data, knowledge, computing model, and method of computation.

Climate change, sea level rise scenarios for Vietnam will be updated following the road map decided in the National Target Program to Respond to Climate Change.

References

1. IPCC (2007), Climate Change 2007. The Physical Science Basics.
2. Ministry of Natural Resources and Environment (2008), National Target Program to Respond to Climate Change.
3. Ministry of Natural Resources and Environment (2003), Vietnam National Initial Communication to the UNFCCC.
4. Nguyen Duc Ngu, Nguyen Trong Hieu (1993), Climate change in Vietnam, Proceedings, Workshop on Climate Change and Adaption Measures, Ha Noi.
5. Hoang Duc Cuong, Pham Thi Duyen (2007), Method for development of Climate Change Scenarios for small region, Proceedings, 10^{t}h Conference of IMHEN, Ha Noi.
6. Nguyen Duc Ngu, Nguyen Van Thang (2008), Global Climate Change, Proceedings, Workshop on Climate Change and Sustainable Development,Ha Noi.
7. Tran Thi Thao, Hoang Duc Cuong (2008), Development of Climate Change Scenarios for the Red River Delta, 11^{s}t Conference of IMHEN, Ho Chi Minh.
8. Houghton, J. H. Meira Filho, L. G., Callendar, B. A., Harris, N., Kattenburg, A., and Maskell, K., eds. (1996), Climate Change 1995: The Science of climate Change. Cambridge University Press.
9. Tom M. L. Wigley, NCAR, Boulder, CO (2008), "MAGICC/SCENGEN 5.3 user manual".
10. Wigley. T. M. L, and Raper. S. C. B (1992), "Implications for climate and sea level of revised IPCC emissions scenarios", IPCC Special Report on Climate Change.

11. WMO and UNEP (2001), "Special Report on Emissions Scenarios", IPCC Special Report on Climate Change, Cambridge University Press.

INFLUENCES OF THE MAN-MADE ACTIVITIES ON LOCAL CLIMATE CHANGES IN HO CHI MINH CITY

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Background

Over the last decade, urban flooding has become worse and resulted in discussions about causes and measures as well to address this problem. In this paper, the author has given his initial comments and provided with a perspective on dominant causes of the current situation of urban flooding in Ho Chi Minh City (HCMC).

Methodology

The methodology of statistical- and correlation analysis has been applied in this paper; mainly to come up with suggestions as an prerequisite for further analysis through hydrological modeling.

Results and discussions

Water level in Sai Gon river

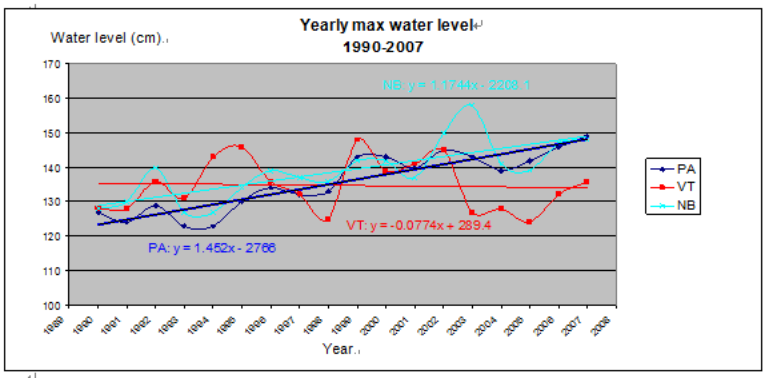

Figure 1: Situation of the annual max water level at Phu An (PA), Nha Be (NB) and Vung Tau (VT) over the period of 1990-2007.

The Figure1 shows that while the water level at Vung Tau has had hardly an increasing trend over the period of 1990-2007, that of Phu An and Nha Be increased about 1.45 cm/year and 1.17 cm/year, respectively. The fact suggests that repeated increases of flooding in recent years may not directly associated with global climate change and sea level rise. This finding would be very important in identifying real causes of the tidal flooding, which has increased rapidly in HCMC, and for proposing appropriate measures to cope with. During the past two decades, economic development resulting in out-of-control urbanization has caused a lowland area leveled to convert to residential areas or industrial zones. Important agricultural land areas have been protected with a polder system against tide. All these given factors might result in

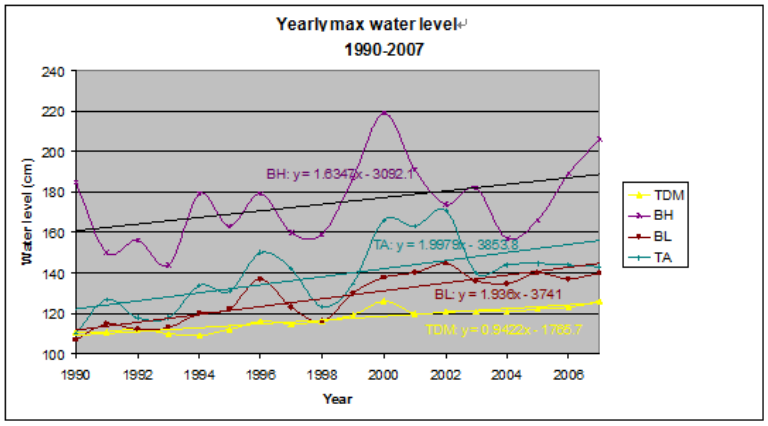

Figure 2: The yearly max water level in rivers surrounding HCMC: Thu Dau Mot (TDM), Bien Hoa (BH), Ben Luc (BL) and Tan An (TA). (see appendix for description)

Station	Phu An	Thu Dau Mot	Nhu Be	Bien Hoa	Ben Luc	Tan An
R	0.29	0.17	0.19	0.56	0.41	0.54

Table 4: Correlation coefficient of yearly max water level at various stations with that sea level at Vung Tau.

the increased trend in the water level in Sai Gon river and surrounding rivers and canals from the 1990's (Figure 2).

To cope with sea level rise, tidal control at rivers' mouths would be an appropriate measure and it should be carried out as soon as possible. However, if the water level increase in rivers and channels surrounding HCMC due to changes in land use in the basin, leveling lowland areas along the rivers and even narrowing rivers and canals by embankments, measure of building up a polder system against tide for the whole region, while sea level rise is still not a major influencing factor, may be not an economical solution.

Relationship among hydrological factors in the area

Table 4 shows the correlation coefficient of the annual max water level at the different stations in the area with that of the station in Vung Tau. Results of analysis in the table 1 shows that there is no correlation at the level of 5% (required R*=0.48) between the annual max water levels at Phu An with that of Vung Tau. The fact implies the sharp increase of water level at Phu An (Sai Gon river), where the historical highest water level recorded in 2008 was 1.55m may not strongly affected by sea level so far.

Table 5 shows the correlation coefficient of the yearly highest water level between the different stations in the area with that of Phu An station. The table 5 shows, except for Vung Tau station, the yearly highest water level at the different stations has a close relationship with Phu An station with the level of 1% (R**=0.66).

Station	Vung Tau	Thu Dau Mot	Nha Be	Bien Hoa	Ben Luc	Tan An
R	0.29	0.96	0.86	0.68	0.88	0.72

Table 5

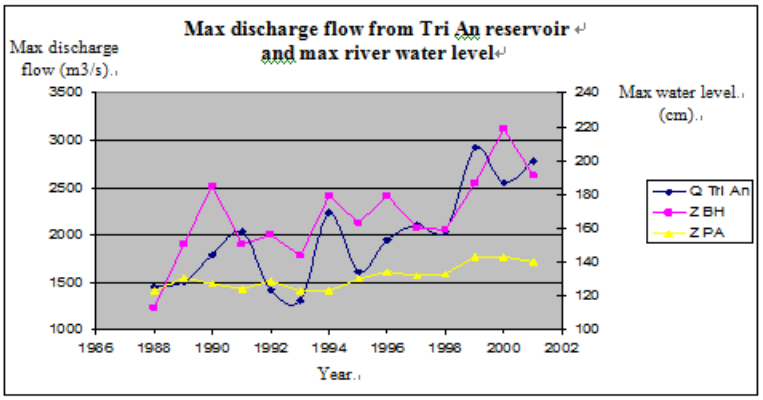

Figure 3: Yearly max discharge flows from Tri An station and the water level at the downstream rivers

Analysis of relationship between the maximum discharge flow and the yearly max water level at the relevant stations

The data in Figure 3 and 4 shows an increasing trend with time of the discharge from the upstream reservoirs. Results of analysis of correlation show that there is a relationship between the max discharge flow at Tri An station and the yearly highest water level at Bien Hoa (R=0.73), Phu An (0.75) and Thu Dau Mot (R=0.71) with a significant level of 5% (R*=0.6). At Nha Be, influence of the flow at Tri An is no more significant (R=0.43).

However, in Sai Gon river, results of the analysis does not show the correlation at the significant level of 5% (R*=0.66) between the discharge flow at Dau Tieng and the yearly highest water level at Phu An (R=0.46), Thu Dau Mot (R=0.64) and Nha Be (R=0.42).

Based on the results of the analysis of the correlation following remarkable observations can be made.

- Influence of the upstream on the yearly highest water level at Phu An station is currently more important than influence from the sea; in which Dong Nai river plays a dominant role. Role of the overflow from Dau Tieng reservoirs has little influence on the water level in the surrounding areas of HCMC.
- The yearly highest water level at the inland stations has strong correlation with the water level in Sai Gon river at Phu An. These results may suggest that the interaction between factors of rivers and canals in the area, or impacts on the water level rise in the rivers might be from the same origin.

In [11], the authors also commented that " . . . the sea level rise due to the warming temperature has not affected on the south of the East sea"

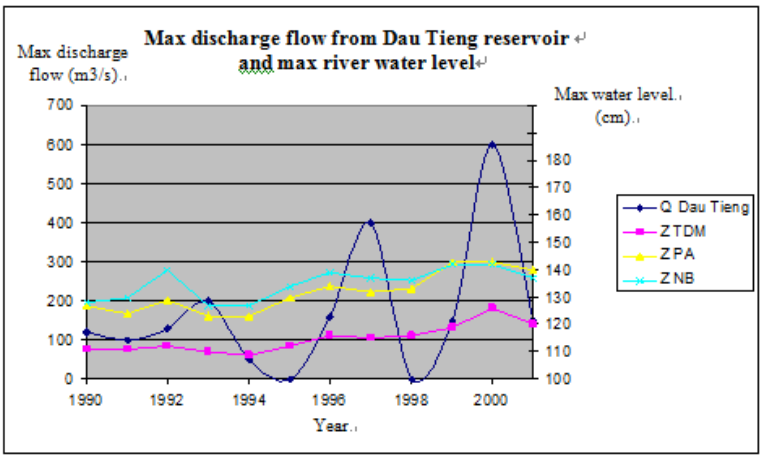

Figure 4: Yearly max discharge flows from the Dau Tieng station and the water level at the downstream rivers

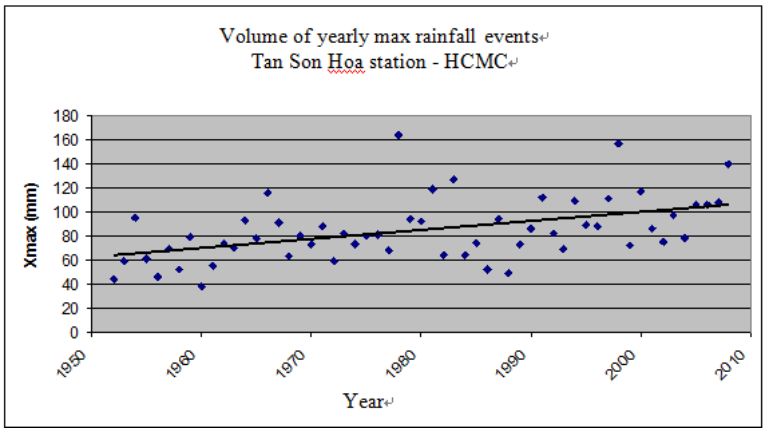

Figure 5: Volume of the yearly max rain events

(p.94, [11]) and "The paper shows that Hmax at Phu An has increased, Hmin has decreased continuously in recent years (different from Vung Tau) due to partial impacts, dyke system and ground leveling." ([11], p. 98).

To come to an exact conclusion, further studies on a changing process in the basin need to be done, which should include: urbanization, land use structure, measures to control water at irrigation systems, situation of rain-flow in the basin, especially ground leveling or water control in the lowland areas along the rivers.

Rainfall

Figure 5 shows an increase of about 0.8mm/year for rainfall of the yearly extreme rain event. Number of rain events with over-projected rainfall as shown in the Figure 6.

Results of analysis have been estimated as shown in the table 6. The table 6 shows that rain events with large rainfall volume has occurred with the frequency becoming higher and higher.

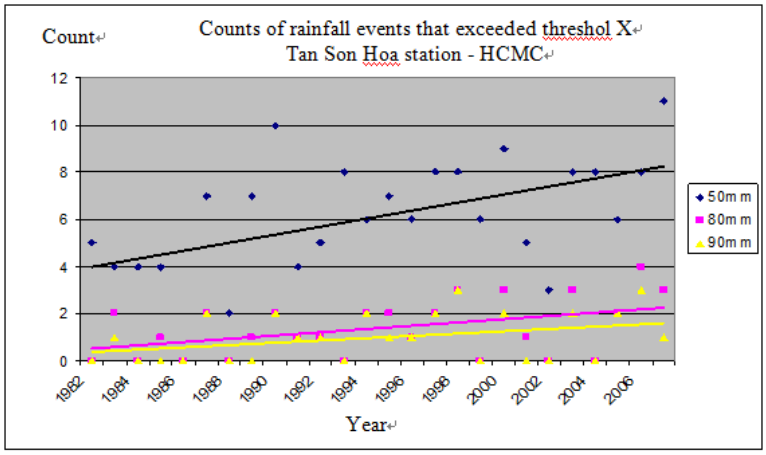

Figure 6: Counts of rainfall events at Tan Son Hoa station, HCM that exceded threshold X (X=50mm, 80mm and 90mm, respectively)

Threshold	1982-1986	1987-1991	1992-1996	1997-2001	2002-2006
50mm	18	30	32	36	33
80mm	3	6	6	9	9
100mm	1	1	2	5	4

Table 6: Statistics of the number of rain events at Tan Son Hoa station in HCMC that exceeded particular thresholds.

Occurrence of heavy rainfall events at an increasing frequency with time has been explained by the theory of Urban Heat Island Effect, although a causal model capable to describe the phenomenon has not been developed.

A continuous increase in the water level in Sai Gon river together with heavy rainfall events that occur more and more frequent, while the drainage systems and tide control works have been hardly upgraded. Consequently, urban flooding in HCMC has been more and more serious. (Table 7).

Temperature

According to the Fig.7 and table 8, Rate of increase in average temperature of HCMC is nearly double compared to the Mekong Delta.

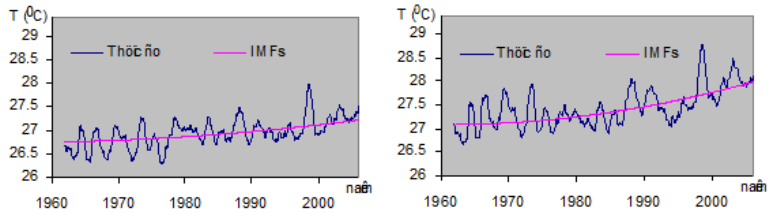

Figure 7: Increased trend in the yearly average temperature in Mekong delta (left chart) and in HCMC (right chart)

Sub-catchment	Count of flooding events per year			
	2003	2004	2005	2006
Hang Bang	112	228	174	180
NL-TN	60	44	58	64
TH-BN	24	21	19	27
TH-LG	72	126	101	95
Van Thanh	20	16	18	19
BT-BL	22	19	22	20
Bac	26	9	23	31
Dong Bac	8	5	6	19
Dong Nam	0	0	0	3
Nam	0	0	0	1
Tay	12	1	2	17
Thu Duc	0	0	0	2
Total	356	469	423	478

Table 7: Flooding situation in HCMC (Source: Urban Drainage Company, HCMC)

Period	Increase in temperature(^{0}C/10 year)	
	Average of Mekong Delta	Tan Son Hoa station
1977-1996	0.13	0.18
1987-1996	0.14	0.26
1997-2006	0.16	0.34

Table 8: Rate of increase in temperature in HCMC and the Mekong Delta during the period of 1977-2006 Source : Luong Van Viet, 2008

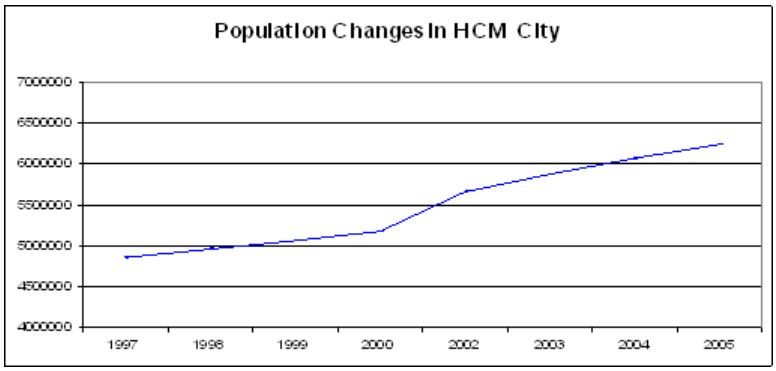

Figure 8: Trend on the population increase in HCMC (1997-2005)

In addition, the trend line (IMF) produced by the Empirical Mode Decomposition method (EMD) also showed that the slope of increasing trend in temperature has been gradually higher after the 1990's, which coincided with the accelerated urbanization process in this area. The facts, once again imply the commonly recognized Urban Heat Island Effect on HCMC.

Urbanization in HCMC

Rate of the population growth is 1,95% per year, 2,63% per year and 4,29% per year during the periods of 1979 to 1989, 1989 to 1999 and 1999 to 2005, respectively [2]. Fig. 3-8 shows that the rate of the population growth in HCMC has rapidly increased trend from 2000. Of which, the population of new urban and suburban districts rises sharply, while the population of urban districts remains unchanged or slightly reduces.

This shows that development of HCMC is strong in the suburban area where its ground level is lower compared to the existing center. Simultaneously, Increase in the construction land area in surrounding areas might reduce significant areas which have function of regulating the water level before.

Together with rise in the population, the construction land area also rapidly increases. The statistical data from the LandSat 5 TM in 1989 and LandSat 7 ETM+ in 2002 shows that percentage of use of construction land in the urban area of HCMC (according to the new margin for the urban area) has increased to 23,9% after 13 years; equivalent to the rate of increase in the use of construction land of 1,85% per year [1].

Local land subsidence in HCMC

Land subsidence has been observed at a number of locations at HCMC. The land subsidence likely makes the flooding level more serious. In addition, designing and constructing of many urban infrastructures have been based on unverified ground levels. A number of typical land subsidence locations is shown in the table 10.

Although the land subsidence has been studied and the final results have not been arrived at yet, similar experience of the cities such as Bangkok, Jakarta, Shanghi, etc., cannot be ignored.

Name of area	Increasing rate of construction land (%)	Remark
District 1	1.7	U
District 2	16.8	D
District 3	2.7	U
District 4	15.3	D
District 5	1.1	U
District 6	26.2	D
District 7	25.3	D
District 8	23.4	D
District 9	11.9	D
District 10	5.6	U
District 11	8.8	U
District 12	33.2	D
Binh Tan District	34.2	D
Binh Thanh District	23.4	D
Go Vap District	50.3	D
Phu Nhuan District	9.7	U
Tan Binh District	16.3	U
Tan Phu District	68.2	D
Thu Duc District	29.1	D
Legend: U – Urbanized area D – Developing area		

Table 9: Increasing rate of construction land over the period of 1989-2002 (Source: Luong Van Viet, 2008)

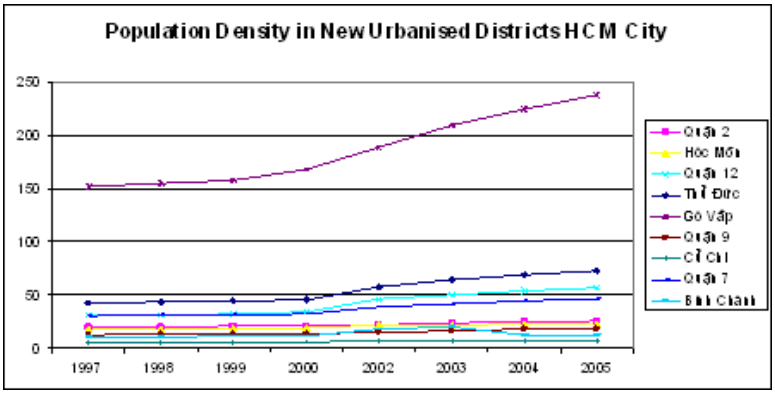

Figure 9: Changes in population density in suburban area (Source: HCMC Statistics Department)

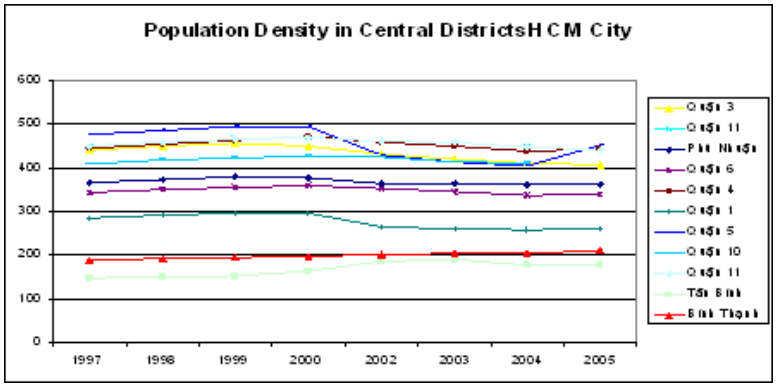

Figure 10: Changes in population density in urbanized area (Source: HCMC Statistics Department)

No	Location	District	Depth of subsidence
1	Binh Tien Co.*	6	13
2	Water supply well 1 *	6	5
3	Water supply well 2*	6	6
4	Housing Dev. Co. *	6	20
5	Ground water level sensing station*	Binh Tan	14
6	Nam Long Co. *	Binh Tan	14
7	Benchmark Q08-056**	8	27.6
Source: * Nguyen van Nga et al, 11/2004 * *H. L. Phi and Nguyen van Hanh, 2007 (unpublished data)			

Table 10: Typical land subsidence locations in HCMC

Conclusions

Major influences of man-made impacts on the basin, eg, discharge regime of reservoirs, urbanization process and measures for controlling the water level at lowlands in the suburban area are likely main reasons of currently unfavourable changes of the water level at HCMC and surroundings. In the same period of 1990-2007, the water level at Vung Tau did not show the same increasing trend. It could be concluded that identification of dominant factors caused the flooding in HCMC in recent decades should be focused on addressing negative impacts at the upstream, surroundings and the urban area of HCMC itself.

For the coming years, as impact of the East sea tide is not yet a major factor of the increase in urban flooding in HCMC, and hence, construction of a polder system for tide controlling starting from the downstream upwards might not be an appropriate urgent solution from an economic perspective. The construction of such a large and costly polder system actually accelerates man-made impacts, which is currently worsening the urban flooding in HCMC.

Analyses of the urbanization process in HCMC have shown changing factors that likely impact negatively between the relation of heavy rainfall and the water level in the area. The fact that over 75% of flooding have occurred in HCMC following rainfall volumes of 40mm and above, even during ebb tide, suggests that the overflow of storm sewer is currently one of major cause of urban flooding. Without upgrading of the sewer systems, tide control polder may play only a minor role in reducing flooding situation in HCMC, especially under pressure of increasing trend of heavy rainfall.

- Planning for urbanization, transport and architecture should focus on the sustainable direction of a gradually decreasing the ratio of impervious area, increasing on-site detention capacity, increasing the albedo coefficient and saving energy to reduce temperature in the urban area for reducing the increasing trend of heavy rainfall.

- In long-term aspect, impacts of the sea level rise and the land subsidence would be becoming more and more prominent and could be quantified. An integrated solution will be required to overcome the adverse impacts, in which the polder systems could be considered.

- So far, all hydraulic studies conducted for HCMC flooding were using just 1D or pseudo-2D models. As the dominant origins could be raised from upstream floods combining with negative activities of urbanization that reduced detention/regulation performance of the low-land areas remarkably, a comprehensive hydrological 2D model should be established for the entire basin taking into account developments/changes in land use (especially wetlands), hydrological system, topography, rainfall of the basin and other relevant factors. Such a model, after being calibrated and verified carefully, will be a good tool to assess man-made impacts and simulate measures to recover the hydrological performance of the basin and to reduce the local water level rise effectively and economically.

References

1. Luong Van Viet (2008). The urbanization and Climate Changes in Ho Chi Minh City. Proceedings of the 10th Conference of Res. Inst. of Hydrology and Environment. pp 369-375. (Vietnamese)

2. Dep. of Statistics Ho Chi Minh City website. URL: http://www.pso.hochiminhcity.gov.vn

3. Feasibility study report of Sanitation and Urban Upgrading project Tan Hoa – Lo Gom. URL: http://www2.btcctb.org/thlg/vn/fs.htm

4. CDM (1999). Feasibility study and Preliminary Design Ho Chi Minh City Sewerage Project Nhieu Loc – Thi Nghe Basin. August 1999.

5. H.L.Phi, 2008. Impacts of Climate changes and urbanisation on Urban Inundation in HCMC. Accepted paper at Intl. Conference of Urban Drainage 11. Edinburg, Scotland.

6. H.L.Phi (2007). Additive approach to analyze non-stationary rainfall series: case study of Ho Chi Minh City. Annual workshop 2007 of Ho Chi Minh City National University.

7. H. L.Phi (2007). Climate Changes and Urban Flooding in Ho Chi Minh City. Proc. The Third International Conference on Climate and Water. Helsinki-Finland Sep. 2007. pp 194-199.

8. H.L.Phi (2005) Impacts of Climate Changes on Urban Flooding in Ho Chi Minh City: Situation and Solutions. The 9th SURED Seminar. Los Banos (Philippines). Feb 28 - Mar 4, 2005.

9. H.L.Phi (2004) Climate changes, Urbanization and Flooding in Ho Chi Minh City. In Nek Maqsud, ed. Presented paper at the Germany-Vietnam workshop "Sustainable Management of Water and Land Resources". Ho Chi Minh City. Nov. 2004.

10. W.P.Lowry (1998). Urban effect on precipitation amount. Progress in Physical Geography 22,4 (1998) pp. 477-520.

11. N.S.Huy et al (2008). Report of Hydraulic Planning for flooding control in Ho Chi Minh City. (in Vietnamese).

Appendix

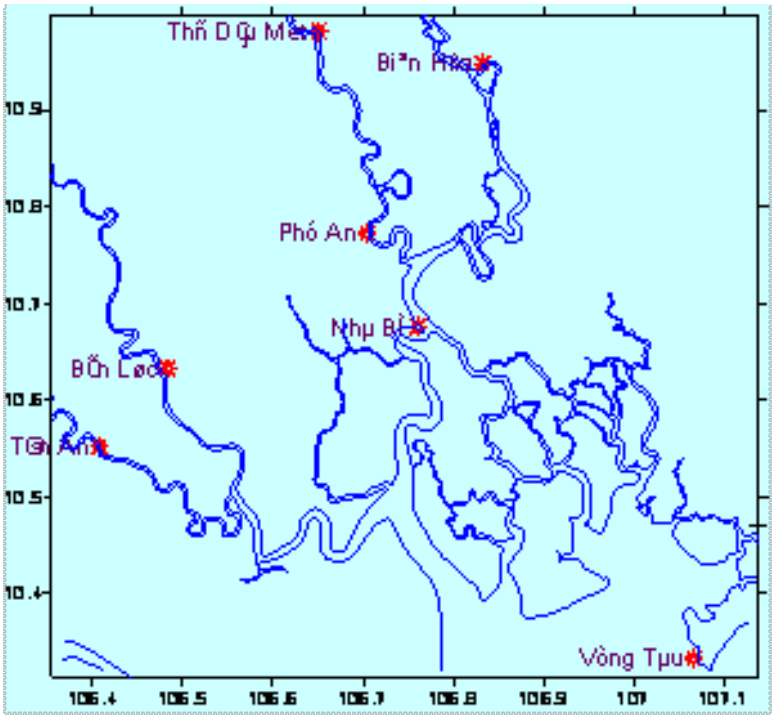

Figure 11: Location of monitoring stations mentioned in the paper.

CLIMATE CHANGE IMPACT ON RICE PRODUCTION IN THE MEKONG RIVER DELTA, VIETNAM

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Abstract

Over the pass ten years, climate change has become one of the most socio-economical and environmental problems for the world. The change of world climate will threaten crop failures, life damage and losses and other critical ecosystem vulnerabilities, especially in Asia and Pacific Ocean region. The Mekong River Delta in Vietnam is the most downstream part of the Mekong River Basin before its water flow out to both the East Sea and the Gulf of Thailand. This Delta is the largest agriculture and aquaculture production region of the nation. Future climate projection from regional climate model indicates that the Mekong River Delta region tends to be warmer in the future with a longer and drier summertime. Seasonal pattern could be altered under influence of global warming. Moreover, changes in the climate pattern in the upstream region of the Mekong River also affect the flood regime of the Mekong Delta, where the boundary of future flood could expand to wider coverage. This paper presents the potential climate change in the Mekong River Delta and the key concerns on future climate threats, especially to the rice production sector.

KEY WORDS: Climate change; the Mekong River Delta, rice production, threats.

Background of the area

The Mekong River Delta (MD) in Vietnam, located in the tropical monsoon zone, is formed by the alluvium deposition of the Mekong River stretching from the border between Cambodia and Vietnam to the sea. The total area of the MD is approximately 28,734 km2 (NEDECO, 1993). Currently, 2.4 million ha are used for agriculture. The average land elevation of the whole Delta is very low and plat, about 1.00 – 1.50 meters above mean see level (Figure 2-1). The Mekong river section in Vietnam is 255 km long accounts for 5.17% the total length of the main river (Tuan, 2000). During the rainy season part of the Delta is flooded. Along the 600 km-coast, the sea tide strongly influences the water quality by sea water intrusion. In addition, an area of 2-million ha is covered by acid sulfate soils. The MD supplies for the country more than 50 percent of the nation's staple food and covers 65 percent of the total fish production. The MD is confirmed as a biggest wetland area of Vietnam (Tuan and Guido, 2007) and a part of the biodiversity conservation Mekong basin.

The MD is the area where the impacts of climate change can be most severe. Historically and practically, the people of the Delta has settled and cultured densely along the river and canal banks. Human life, agriculture and aquaculture production, domestic water supplies

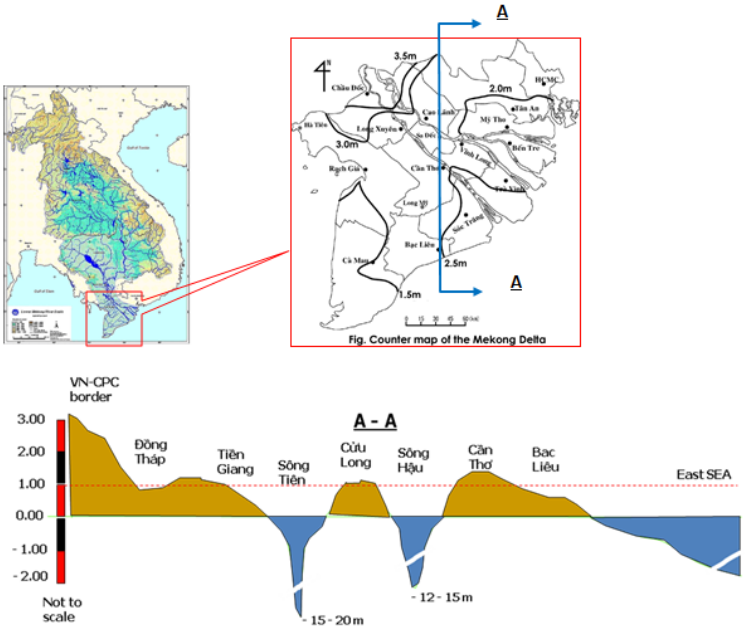

Figure 12: Map of the Mekong River Basin, elevation of the MD and a typical cross-section of the Delta.

in the Delta depends highly on the meteorological and hydrological regime. This livelihood condition is sensitive and could be threatened by changing climate and hydrological cycle. The objective of the paper is to present the projected threats and to analyze the impacts to the rice production of the Delta.

Some projection in climate change

Many scientists and international organizations have classified Vietnam, especially MD, as a vulnerable area for climate change and sea level rise (Peter and Greet, 2008; Dasgupta el al., 2009; IPCC, 2007; UNDP, 2007; WB, 2007; ADB, 1994). In 2009, Southeast Asia START Regional Center (Chulalongkorn University, Thailand) and Research Institute for Climate Change – Can Tho University have collaborated in simulating a regional climate model namely PRECIS for downscaling coarse scale Global circulation models (GCM) output to derive climate change scenarios for MD. The scenarios of A2 and B2 are applied on the weather data of period 1980 – 2000 to project the climate images for the period 2030s. The results show that there are many areas of the MD that will be impacted as follows:

- The highest temperature in the dry season will increase from 33 – 35 ^{o}C to 35 – 37 ^{o}C (Figure 13).
- The precipitation at the beginning of the Summer – Autumn (from 15th of April to 15th of May) will decrease about 10 – 20% in main rice production areas of the Delta (Figure 14). The starting time for the rainy season will be 2 weeks delayed in An Giang, Can Tho and Soc Trang (Figure 15).
- However, at the end of the rainy season, the precipitation will increase that threat the rice crop harvest period (Figure 16).

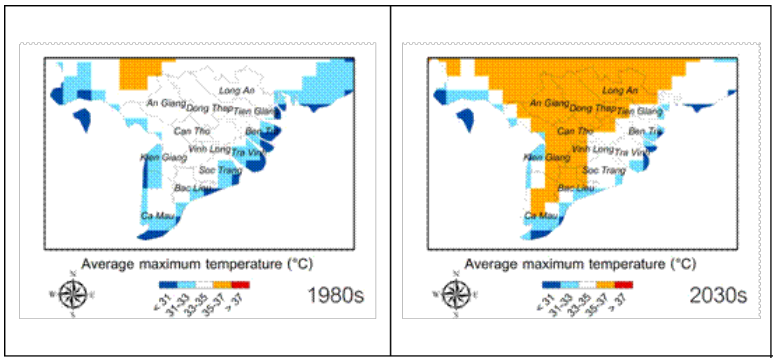

Figure 13: Average maximum temperature in MD in 1980s and 2030s (simulated)

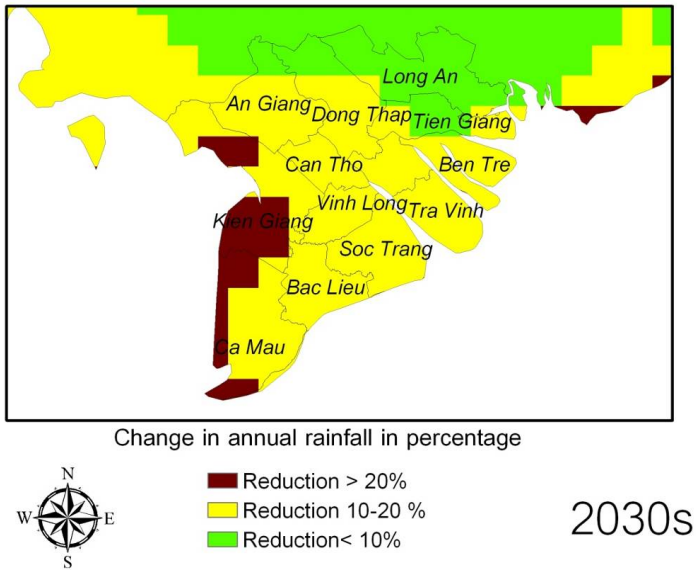

Figure 14: The decrease in the total precipitation in 1980s and 2030s (simulated)

The result is relatively similar to that by IPCC (2007) that show the tendencies: (i) the global temperature will increase 1 ^{o}C during 2010 – 2040 and 3 - 4 ^{o}C during 2070 – 2100; (ii) the global precipitation will decrease during 2010 – 2040 while increase during 2070 – 2100 (Figure 17).

The model also show the changes in the flooding patterns in the delta during 2030 – 2040 compared to the current status: the flooded area will be extended towards areas of Bac Lieu – Ca Mau (Figure 18). However, the number of flood days in upstream provinces will reduce (Figure 19).

Impacts of climate change on rice production

The situation where the temperature increased, precipitation decreased, flooded areas extended and sea level increased will impact significantly to the agricultural activities in general and to the rice production in particular. Rice production will face most difficulties, as the change

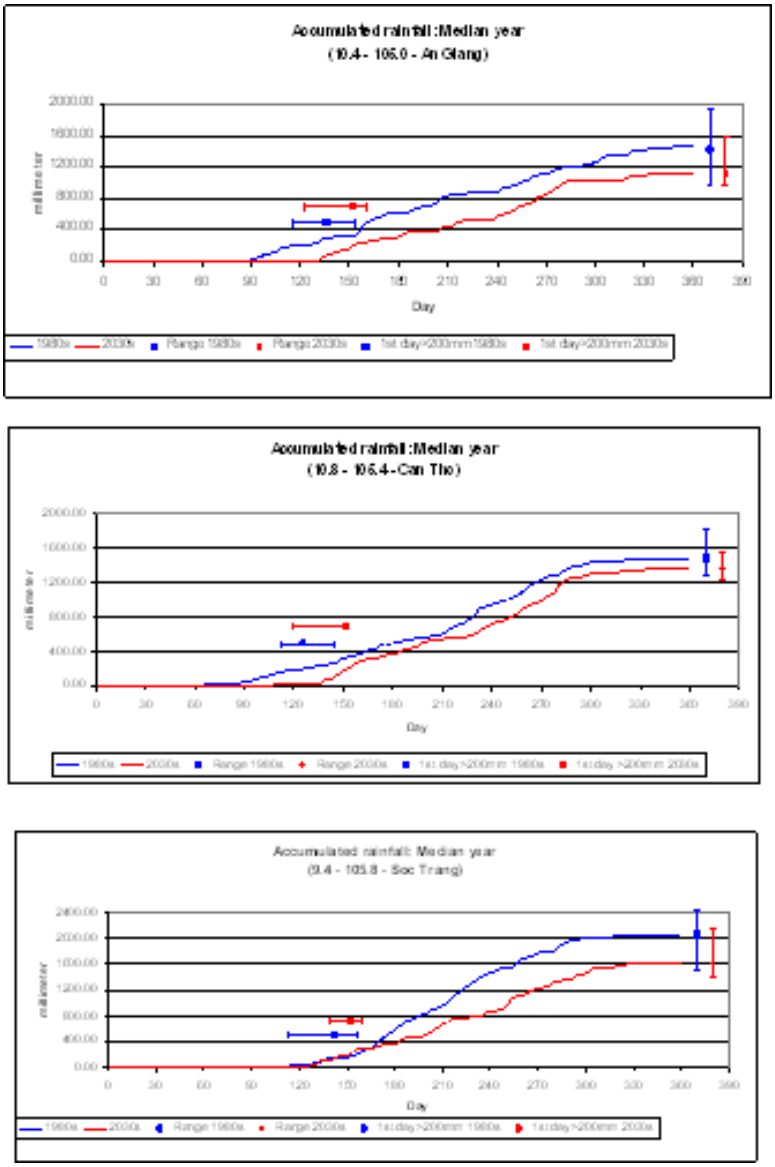

Figure 15: Changes in starting time for rainy season, accumulated precipitation in 1980s and 2030s (simulated) in An Giang, Can Tho and Soc Trang.

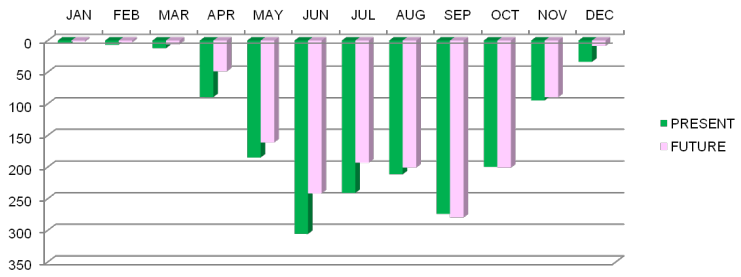

Figure 16: Changes in monthly precipitation in present (1980s) and future (2030s)

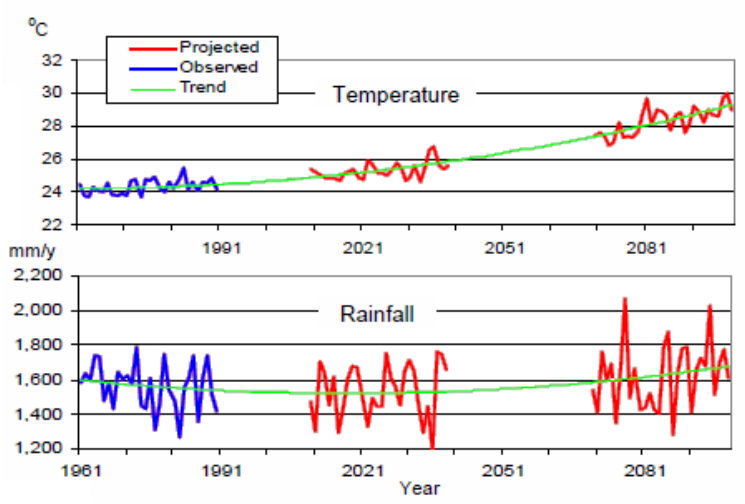

Figure 17: Changes in temperature and precipitation (IPCC, 2007)

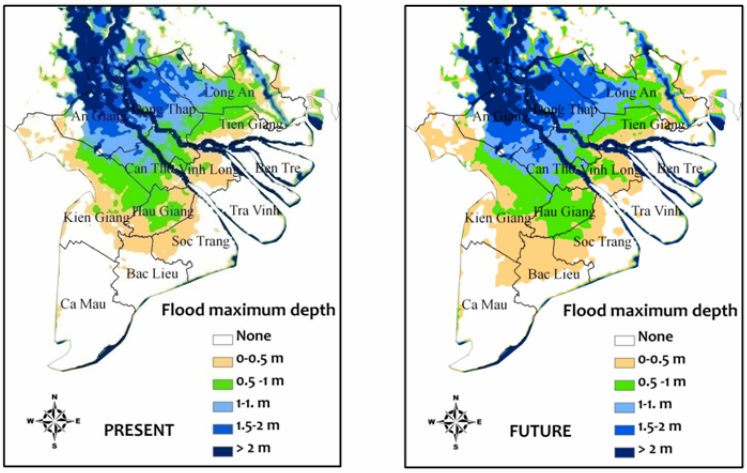

Figure 18: Changes in flood maximum depth in present (1980s) and future (2030s)

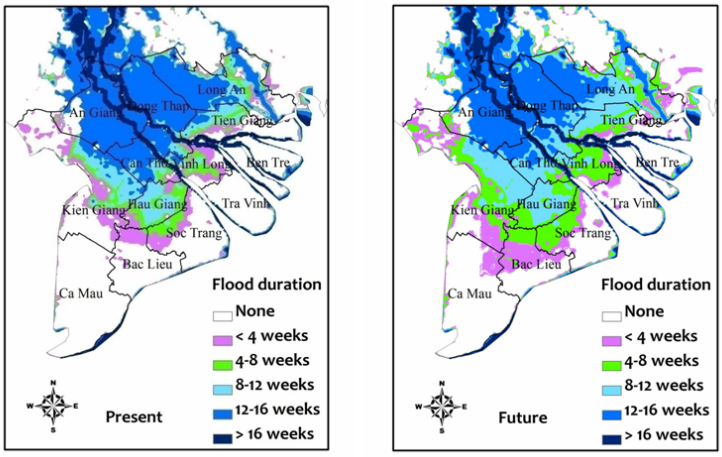

Figure 19: Changes in flood duration in present (1980s) and future (2030s)

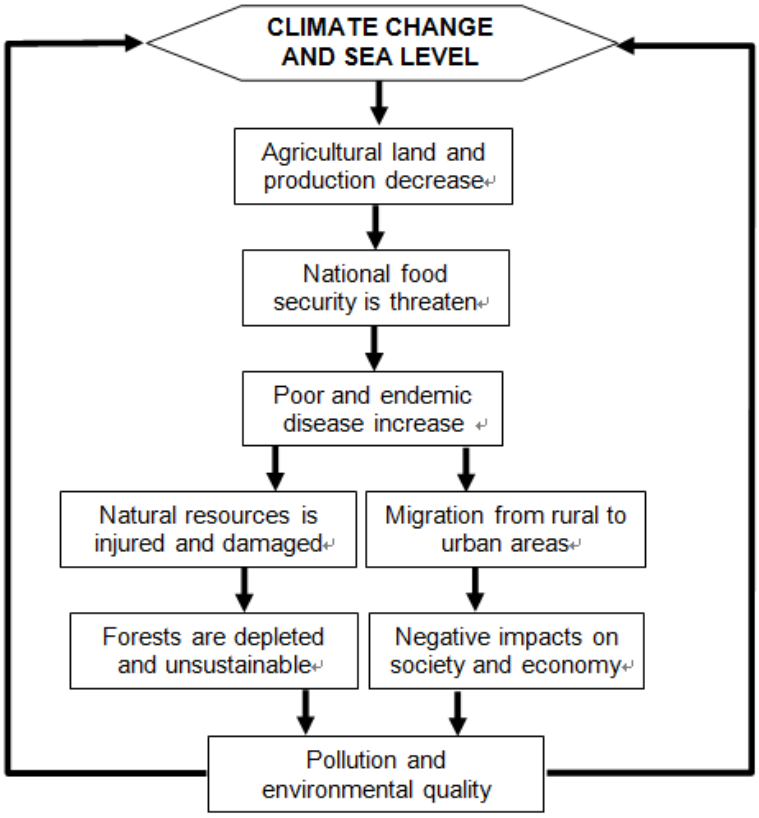

Figure 20: Foreseen impact chain from climate change on agricultural production and likelihood and ecological system (Tuan, 2009)

in climatic pattern as well as flood regime in the MD will add more pressure to the livelihood of the people in the delta area (TTK & SEA START RC, 2009). This climate change will also be a threat to the ecological system, environmental quality and to the socio-economic development of the whole Delta (Figure 20).

Concerning rice production in the MD, it can be foreseen, in the future:

- The changes of maximum temperature, monthly precipitation distribution and flood duration are main factors affecting rice planting areas and the growth of rice. The change of average temperature in the future seems still favourable for rice growth but the development of harmful insects due to the increase of temperature may be a serious problem. Rice productivity can be damaged by the serious droughts and floods in the future.

- The rice farmers in the Delta will pay more money for water pumping when the precipitation reduces in early of rainy season and increases in the beginning of the flooding season. That means their income from rice production will be reduced.

- Rice production area, as well as other secondary food crop area, will be narrowed down and affected by climate change and sea level rise that leading to decrease of yields and total production. This will cause the threats to the food security for the nation.

- Rice farmers, shrimp farmers, salt farmers and small agricultural businessmen will be significantly impacted due to the lack of essential nutrient sources, land ownership, financial sources and information assessment for adaptation the climate and flood regime change. As a consequence, resources areas of forest, land, water, wildlife, natural mineral will be encroached, over exploited and damaged.
- As another consequence, there may be migrations of farmers in coastal areas that are seriously impacted by climate change and sea level rise to the urban areas in the North and the West of the Mekong River Delta (such as Chau Doc, Long Xuyen, Can Tho, Vinh Long, My Tho, Tan An). This will have negative impacts on the urban planning and order of the society. Urban environment will be degraded due to the unplanned increase in the population.

Recommendation and proposal on future research

This study is based on single scenario, which only represents a single plausible future. Many scientists recognize the phenomenon of climate change itself and sea level rise although analysis about their details is still being carried out. The MD region is considered to be one of the most seriously impacted areas in the South East Asia in terms of rice and other food production, ecology and socio-economic. This is a critical issue that regional planners, policy makers, academic scientists, businessmen, local officers and people have to be aware of. There must be policies on information sharing and measures to mitigate and adapt to the climate change. Inaction due to uncertainty and irresponsibility will cause adverse consequences to future generations. It is necessary to have a collaboration research on simulating climate change for different periods with different scenarios and identifying subjects that are impacted and assessing the levels of impacts.

It is suggested that an action plan for climate change mitigation and adaptation be drafted. The guidelines for climate change adaption are needed to written down. Figure 21 is an approach, namely 5A approach, to take practical measures to adapt the climate change.

Acknowledgement

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References

1. ADB (Asian Development Bank), 1994. Climate Change in Asia: Vietnam Country Report, p.27.
2. Dasgupta Susmita, Benoit Laplante, Craig Meisner, David Wheeler, and Jianping Yan, 2007. The Impact of Sea Level Rise on Devel-

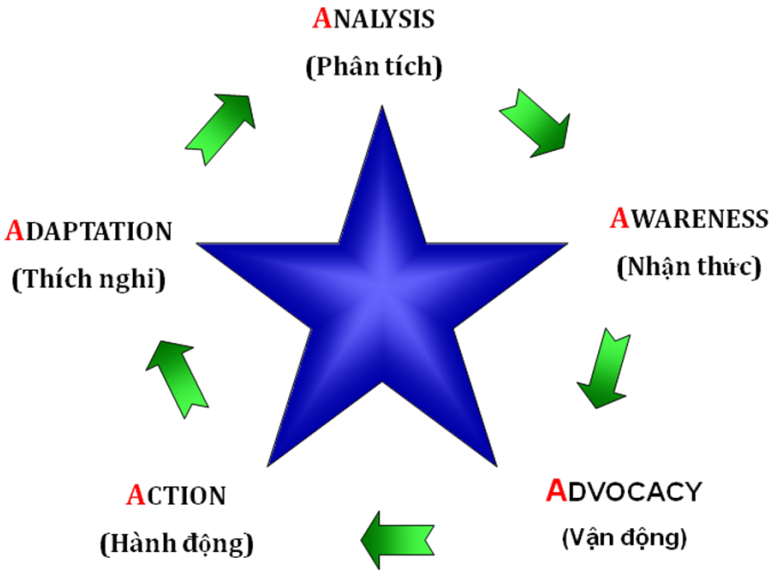

Figure 21: Five practical steps for climate change adaptation (Tuan, 2009)

oping Countries: A Comparative Analysis. World Bank Policy Research, Working Paper 4136, February 2007.

3. IPCC (Intergovernmental Panel on Climate Change), 2007. Fourth Assessment Report, Working Group II report. Impacts, Adaptation and Vulnerability.

4. TTK & SEA START RC, 2009. Water and Climate Change in the Lower Mekong Basin: Diagnosis & recommendations for adaptation, Water and Development Research Group, Helsinky University of Technology (TTK), and Southeast Asia START Regional Center (SEA START RC), Chulalongkorn University, Water & Developmement Publications, Helsinky University of Technology, Espoo, Finland

5. Tuan Le Anh and Guido Wyseure, 2007. Action Plan for the Multi-level Conservation of Forest Wetlands in the Mekong River Delta, Vietnam. International Congress on Development, Environment and Natural Resources: Multi-level and Multi-scale Sustainability. Cochabamba, Bolivia.

6. Peter Chaudhry and Greet Ruysschaert, 2008. Climate Change & Human Development in Vietnam: A case study for the Human Development Report 2007/2008. Oxfam and UNDP.

7. NEDECO (Netherlands Engineering Consultants), 1993. Master Plan for the Mekong Delta in Vietnam. Summary Report. Government of Vietnam, World Bank and UNDP.

8. UNDP (United Nations Development Program), 2007. Human Development Report 2007/8, Fighting Climate Change: Human Solidarity in a Divided World. Palgrave MacMillan, New York.

VALUATION OF ECONOMIC LOSS CAUSED BY EXTREME EVENTS AND THE ROLE OF UNIVERSITIES IN RESPONDING TO CLIMATE CHANGE

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Abstract

The way we use energy has pushed our planet in a dangerous stage. Climate change and its negative impacts have turned to be the most serious threats to sustainable development of every country. Viet Nam, moreover, is considered as one of the most vulnerable countries to climate change.

Facing with this global threat, each country, organization and people are responsible to plan and implement prompt actions to minimize the negative impacts. Among those factors, universities have a very important role to study the problem, to support governments in looking for appropriate solutions, and to upgrade population's knowledge of how to mitigate and adapt to climate change.

The College of Economics, Vietnam National University-Hanoi is on the way to set up a new major with the title: "Valuation of economic loss due to climate change". Besides the intention to form a set of subjects for lecturing, we desire to set up an interdisciplinary research domain that could attract talented experts from relevant fields to team up and work for this purpose. We believe that Economic Loss Valuation will be a useful and reliable tool for government and communities in combating climate change.

Climate change and its consequences

Consequences of climate change and socio-economic problems

According to the IPCC, climate change will be noticeable by various impacts. Temperatures and rainfall will change, sea levels will rise and droughts and floods will occur more frequently. This may cause the change in vegetation zones, an increase in disease levels, a change in ecosystems.

Temperature increase will make polar ice melting. It has been predicted that by 2090 the entire North pole may be completely free of ice. The total amount of global rainfall will increase. However, there will be regions that will receive less rainfall than before the changes took place. Temperature change has an impact on movement of ocean flows and this disorder in its turn will result in stronger impact on climate change.

Ice melting in pole regions is the main reason of sea level rise. The IPCC predicts that sea levels will rise by about 18 cm by 2040 and by about 48 cm by 2100 in the most extreme case. The rise in sea level would also make millions of people homeless and ruin valuable farmland. This will be a giant threat for countries where the large part of the population currently lives on low land that will be flooded.

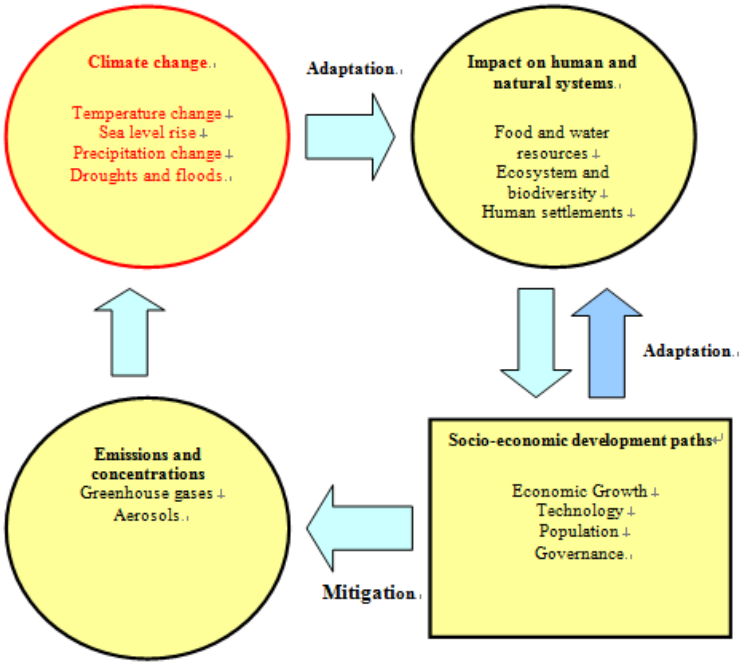

Figure 22: Projections of consequences of climate change (Source: IPCC)

Ecosystems could be affected by a change in temperature. It has been predicted that an increase in temperature would affect species composition; up to two thirds of the world's forests would undergo major changes; deserts would become hotter, and desertification would extend and become harder to reverse.

As was mentioned before, temperature and sea level change cause the frequency of droughts and floods to increase. More people will experience flooding of their lands and homes and extreme drought will negatively influence crop yield.

This change in vegetation zones could cause famine in dry areas depends on a certain type of crop. The change in vegetation would cause mass movement of people away from dry regions. This could cause huge over-crowding in towns and cities.

Climate change influences many other environmental issues, such as air quality, water quality, desertification, biodiversity, forestation. This could bring about an increase in disease levels.

Seawater intrusion into freshwater is an increasing problem with rising sea level. One consequence of saltwater incursion will be that during dry seasons shortages of freshwater for agriculture are likely to be more pronounced and agricultural yields seriously reduced.

It is believe that temperature increase and ocean flow change is closely linked with the more frequent occurrence of extreme weather events such as hurricanes, cyclones, flooding and drought. Past history indicates that loss of life is significant storm-surge flooding occurred.

Such disasters that include increased droughts, desertification, sea level rise, and the more frequent occurrence of extreme weather events such as hurricanes, cyclones, and flooding will result in series of problems: Hunger, poverty, inequality, backwardness and death.

Impacts on Vietnam

Viet Nam is considered as one of the most vulnerable countries due to climate change and sea level rise. If sea level rise of 1 m, Viet Nam will loose about 12% of land, 23% of population will be affected. Typhoons occur more frequently with higher intensity. Temperature increases and change in rainfall pattern will affect agriculture and water resources.

Not so different from other countries, Vietnam usually experience extreme events such as typhoon, heavy rain, strong wind, flooding, high tide, drought, saltwater incursion. Vice Prime Minister Hoang Trung Hai in a speech in May 2008 as quoted as saying that more than 11,500 billion VND had been lost, 400 people died as consequence of typhoons in 2007. During 2001-2006, the annual loss due to extreme events in Vietnam was equal to 1% of GDP.

HURRICANE: From 1954 to present, 212 hurricanes have affected Vietnam, in which 4 or 6 hurricanes occurred per year in average. In some specific years, this numbers turned to be extremely high. For example, in 1964 (18 hurricanes), 1973 (12), 1978 (12), 1989 (10).

HEAVY RAIN: In Vietnam heavy rain usually goes with strong wind. Of about 70 or 80% of the total rainfall is observed from July to November ever year (2,500 mm/year). Maximum rainfall in 12 hours is 702 mm; in 48 hours is 1,217 mm. Almost heavy rain occurs at the same time with hurricane and usually results in flooding. Hanoi suffered a historical flood of magnitude equivalent to a hundred year return period flood in 2008 due to a long and heavy rain.

FLOODING: There is great difference in flows between dry and rainy seasons of Vietnam. In dry season, the flow is about 0, 3% and in rainy season is 30% of the total flow of the year. Thus, flooding in raining season is a real threat of any river in Vietnam. In case of flooding, especially sudden sweeping flood, the event should create huge destruction to houses, harvest and claim a lot of lives. Change of river flows: Climate change is one reason that leads to change river flow. The change of river flow may create serious land erosion, aggradations and deposition both in up stream and down stream of rivers. Deposition and mud flood also create huge harmful to irrigation systems and hydroelectric plants.

SEA LEVEL RISE AND HIGH TIDE: For recent 50 years, sea level in Vietnam has risen about 20cm. High tide usually create flooding in Ho Chi Minh city. In coastal areas, tens of million of farmers are going to loss their cultivation and houses. Industrial zones and infrastructure systems are going to be useless. Starvation and social evils tend to return. According to Ms. Ursula Schaefer from ADB, Vietnam should lose of 6.7 % of GDP by 2100 if necessary preventing solutions may not be applied in right time.

The follow is illustration of sea level rise in Mekong Delta area in different scenarios.

The Mekong Delta comprises 13 provinces, 39,712 km2, (12.1% of the country area). Population: 17.4 million (2006), 21% of the total.

Figure 23: Illustration of sea level rise in Mekong Delta area in different scenarios.

Agricultural output: 50%; exported food productions: 90%, fruit trees and aquaculture products: 70% of the whole national output. Most of the natural area has a very low elevation (below +2.0m). The level of sea tide (rising up to +2.14m) is an agent transmitting the tidal effect to the extremely far Mekong Delta area along main rivers. According to IPCC interim recommendation 2007, in case of sea level rises up to 1m, an area of 15,000 to 20,000 km2 in the Mekong Delta would be flooded.

A lot of dangers and threats as consequences of climate change can be recognized and identified. However, one very important issue is that in case of an extreme event occurs, how much is the loss should be? What is most economical solution for the problem in long-term? To answer these questions are responsibilities of economists.

The role of universities in responding to climate change

Warning the dangers and advising governments for appropriate actions

Climate change is not a problem of a single government or a country; it is the global problem and generation problem. It needs a strong and close collaboration of all governments, countries and peoples in the world to deal with climate change impacts. Scientists and universities are responsible to launch a worldwide movement to help poor nations cope with the impact of global warming, and to share experiences that could help vulnerable people adapt to climate change.

An important issue to succeed the Kyoto Protocol is to launch a global movement of reduction greenhouse gas emissions. However, this is not an easy issue. A number of developing countries are now stuck in the dilemma between short term pressing targets and sustainable development goal. Industrialization is recognized as a main solution to deal with poverty of these countries. However, factories, mills and households may not cut off their demand for traditional energies. Low technology and inefficient of energy usage has resulted in carbon emission increase. Serious pollutions, diseases and negative impacts of climate change would turn to be a heavy burden in their homeland. This seems to be a new kind of poverty trap for those economies.

It must be the responsibility of scientists and universities to make warnings and to advice governments regarding the loss and win, the cost and benefit of each policy. It is also the task of scientists and universities to look for new and clean energies for a sustainable development of the globe, and to find solutions for mitigation and adaptation to climate change.

Raising public concerns and upgrading knowledge of population

Strong evidences found showing that demographic change is closely associated with greenhouse gas emissions, and that population dynamics will play a key role in attempts to mitigate and adapt to the effects of changes in the climate system in the future. A new study also found that knowledge of population and the population behavior towards energy spending is a very important factor to combat climate change.

Before the long-term and fundamental solutions could be found, urgent problems need urgent solutions to mitigate and adapt to ongoing impacts of climate change. All these changes could occur if we carry on polluting the atmosphere with gases. There are many things we as individuals can do to help slow down any increase in global temperatures.

When a people acknowledge how climate change affect humans, agriculture, vegetation, the ozone layer, hydrology, invertebrates, marine life, forests, birds, and the freshwater environment, he/she can understand what should he/she do to save the earth. One way we can cut down on the amount of carbon dioxide we use by event a quite simple decision, such as to take a bus instead of a car, ride a bicycle or just walk whenever it is possible. We could also use less carbon dioxide by using better insulation in our homes. This would lessen the need to burn fossil fuels that give off carbon dioxide. We could also switch to using renewable sources of energy such as wind or solar power.

Similarly, understanding demographic trends, including fertility, population growth, urbanization, migration from environmentally depleted areas, and growing population density in marginal and vulnerable areas, is also crucial for the world to adapt to and cope with the adverse impacts of current and projected climate change.

In Vietnam, flooding, especially mud flooding is one of the most dangerous events that claim a lot number of lives. Some people who build their houses in excavated spot by the steep slope of hills. Some others build their houses in the original river bed. This shows the lack of public concern and poor knowledge of the local people. These house and their owners had been swept away due to heavy rains and floods.

Many lives and houses could be safe if the victims have been trained and warned of the dangers.

The most effective solution would be education for initially upgrading knowledge of the population of climate change, bewaring of the danger, actively preventing impacts of potential disaster. The education program should rely on science researches, be compiled briefly, suitable for everyone to understand. Students can be taken into short training or coaching program to share their knowledge with local people. Universities should hold a special position in combating with climate change impacts, as the higher education sector is the most suitable organization to conduct researches, training and launching scientific propaganda with significant spill over effects to the whole society.

According to Prof. Mai Trong Nhuan, VNU HN President, universities play a vital role in the national action plan dealing with climate change impacts.

Economic Loss Valuation: a basic stage for solution seeking

The role of Economic Loss Valuation

As mentioned previously, it would be no use to study climate change and do nothing about it. Climate change and its consequences have turned to be real and huge threats that may not be removed, or stopped overnight. Mitigation and adaptation to climate change would be the way to proceed. Among important efforts of scientists in looking for technological, geological or social solutions, economists may want to find out what are the main components of the loss incurred by each disaster, and what solution would be the most economical one to be applied in such a case? Within this specific domain, valuation of the economic loss is one of basic tools to identify appropriate solutions.

In case an extreme event has been valuated, the total loss may reflect the economic burden of the economy for suitable policy adjustment. Necessary policies may be made in time to mitigate the loss and preventing further harmful effects. The loss components may reflect the vulnerable of relevant economic branches, weak or strong points in state organization and operation. Another important thing is that the long-term investment and development programming can be checked under the light of sustainable developing goal. Lessons from actual losses can be clear instructions for policy adjustment, development strategy reviewing.

Fact findings from a valuation survey revealed that there is a strong, positive correlation between the losses and the vulnerability level. Not surprisingly, the vulnerable level may depend on the nature and also depend on decision or behavior of the people. Valuation of economic loss is able to show the way to minimize the loss in changing decision or adjusting behavior.

Methods of Economic Loss Valuation

In order to valuate economic losses caused by an extreme event, we can estimate the total economic losses by summing up (i) environmental loss, (ii) economic activities loss, (iii) value of destroyed infrastructure items, and (iv) direct expenditures for emergency rescues.

The most sophisticated items of these would be the environmental loss valuation. Fortunately, we can use environmental valuation technique with the approach that the different of the environmental values before and after the event can be accounted as the environmental loss of an event.

ENVIRONMENTAL VALUES Be considered as direct inputs into the production process, environmental resources provide a complex set of values to individuals and benefits to society. Coastal areas, for example, offer scenic hobbies and recreational operation. Fish and other sea creatures caught in coastal areas provide food to people. These are only the direct benefits. There are also values that are not directly tied to use, such as climate modulation, physical protection, and stewardship for future generations. All of these benefits are relevant in environmental valuation. Total economic value is represented by the following equation:

Total environmental value = direct-use value + indirect-use value + non-use value + intrinsic value

Use values, such as fishing and hiking, are the more direct and quantifiable category of environmental values, but they capture only a portion of the total economic value of an environmental asset. Indirect-use values, non-use values, and intrinsic values are also associated with preserving environmental resources. Indirect-use values associated with coastal areas include biological support, physical protection, climate modulation, and global life support. Non-use values are less direct, less tangible benefits to society and include option and existence values. The option value is the value an individual places on the potential future use of the resource. Existence values include bequest, stewardship, and benevolence motives.

There could be a controversial issue in valuating non-use value and intrinsic value for some one argues that up to now, human beings have not identified full value of things in the nature. That is correct, however, we should have to agree with one rule that valuation methods shall not be able to move out of current knowledge of the mankind.

ENVIRONMENTAL VALUATION METHODS The individual preferences are able to value environmental resources. Environmental economists have developed a number of market and non-market-based techniques to value the environment.

ENVIRONMENTAL VALUATION METHODS

Market based Methods Factor of production
Producer/consumer surplus
Defensive expenditures
Surrogate market Methods
Hedonic pricing
Travel cost
Random utility models

Non-Market Methods Contingent valuation
Choice experiments

Market-Based Methods rely on direct, observable market interactions to place monetary values on goods and services. There are a number of market-based methods, in which the most popular are: (i) factor of production approach, (ii) change in producer/ consumer surplus, and (iii) examination of defensive expenditures.

Surrogate Market Methods are used in case of absence of clearly defined markets. The value of environmental resources can be derived from information acquired through surrogate markets. The most common surrogate market methods can be mentioned here are; (i) the Hedonic price method, (ii) the Travel cost method, and (iii) Random Utility Models. It is necessary to note that RUM is not specific to surrogate market techniques. It is an estimation procedure that can be combined with surrogate and non-market techniques used in valuing.

Non-Market Methods use the technique that identifying environmental preferences from individuals through surveys, questionnaires, and interviews. The most useful methods can be addressed are (i) Contingent valuation, and (ii) Choice experiments.

COE-VNU HN actions

VNU HN: An address for interdisciplinary researches

Valuation of economic loss due to climate change is a work that needs a large number of data from different scientific field, such as geography, hydrography, meteorology, civil engineering. Within one extreme event, such as in a hurricane, a large number of impacts should occur all together for example heavy rain, strong wind, flooding, land slide, erosion. Specific impact on specific object also leads to different consequences. All of these matters cannot be covered within small groups of limited fields, or within economics. This is truly the interdisciplinary research domain.

In comparison with other universities or institutes in Vietnam, VNU-HN is holding a favorable situation in which the University has a number of member colleges or member faculties that would be able to cover almost all the above mentioned academic fields, from geography, hydrography, meteorology, civil engineering, physics, biology, etc., to economics. A more important character is that VNU-HN possesses a long tradition of fundamental science studies that attracted a large number of leading experts and professors.

Among other members, the College of Economics is an old member but a young college of the University. If valuation of economic loss can be divided in to several stages, the earlier stages may be the works of geographers or biologists, the later one and can be the work of economists. This can be called the afterward stage to come to a conclusion of how much is the loss incurred in the extreme event. To ensure the reliable and feasibility of a research a long these different stages, it need special institutional atmosphere, such as in VNU-HN.

In addition to the working spirits and the tradition of close collaboration among the university members, VNU-HN can be considered as a right place to launch interdisciplinary researches, such as valuation of economic loss due to negative impacts of climate change.

What we have done?

It is a fact to say that our college is young and the major "valuation of economic loss due to climate change" is younger. We have started the work for two years now and quite a few things have been done.

The first one can be recalled is a collection and synthesis of theories and methods for valuating environment, habitat and economic loss due to extreme events. This is a science research of National University rank, be implemented within two years and finished by May 2009.

The second one is a research and a site survey with the title: "Valuation of Economic loss caused by oil spill event in Cu Lao Cham (Da Nang province) in January 2007". In this research, we use several valuating methods, such as market-based method to valuate the loss of fishing, salt producing; travel cost for tourism; contingent valuation for losses of habitat and biodiversity. However, the pollution agent was a kind of dreggy oil; this would be a special case of oil pollution. The research was finished by June 2008.

Within the scope of research program of VNU-HN, we are conducting four researches:

1. Flooding in Cua Dat (Thanh Hoa province), There is a dam of medium hydroelectric generation plant had been build in Cua Dat river. Valuation of economic losses is based on scenario of the dam broken and the sudden flooding would sweep along the down stream.

2. Sea level rise in coastal area of Red River Delta. The research aims at valuating losses incurred a long the costal area of Thai Binh, Nam Dinh and Ninh Binh provinces in accordance with different scenarios.

3. Soil depression in Hanoi. The weak soil layers of sand and alluvium beneath Hanoi, in addition to uncontrolled exploitation of underground water are main causes to soil depressions in Hanoi. This could be seen in temporally flooding recently occurred in the city. Evidences have been found of interactions among climate change and underground water exploitation and the soil depression in the Red River Delta. Consequences of soil depression incurs a huge loss regarding land price goes down and other economic losses by floods. If the total losses can be estimated, this would be important input for the new sewage system projecting.

4. Land slides in Bac Kan province. As mentioned above, land slides are often occur in raining season in mountainous areas and considered to be the most dangerous event that claims a lot of lives. The research is necessary to valuate losses caused by land slides and also to raise public concerns and upgrade knowledge of local people in mitigation of the consequences.

Action plan in the coming days

THREE RESEARCH PROGRAMS It is not easy to achieve a reliable answer of "how much looses have caused by an extreme event". However, it would be less meaningful if a research is to answer only such one question. Politicians and policy makers might require foreseeing

and broadcasting information of potential losses of extreme events in different scenarios that have not actually occurred. The matter here is how to use data revealed from surveyed events for future forecasting and predictions.

Total losses of an extreme event can be seen as the value function among: (i) impacting agents; (ii) a set values of impacted objects, and (iii) vulnerable levels of the set of impacted objects. In order to obtain a reliable forecasting scenario, it is necessary to set up a research program to systematically look for those variables including economic value of targeted regions and the possible loss due to different scenarios for typical objects. Thus in the coming days, we intend to conduct three research programs as sum up as follows:

SEA LEVEL RISE: A research program for valuating economic losses due to sea level rise along the coastal areas of Vietnam.

Five typical locations had been selected including: Nam Dinh (mangrove, farming, rural residences); Quang Binh (fishing, salt producing); Da Nang (local industries, port operations); Nha Trang (tourism, habitat); Ca Mau (inland water area). This program is to collect primary data of actual losses in typical economic regions. With sufficient budget in the future, the program could be expanded to conduct additional surveys in more locations to look for impacting coefficients between sea level rise and potential losses of the detail objects.

TYPHOON: A research program for valuating economic losses due to typhoon in different areas of Vietnam.

Five typical locations had been selected including: Bac Kan (flooding, land slide); Nam Dinh (agriculture cultivating); Thanh Hoa (industry and infrastructure systems); Hue (urban, relic and tourism); Da Nang (fishing, aquatic feeding). Similarly with the first program, this program is to collect primary data of actual losses in typical economic regions caused by typhoons and their consequences. Impacting coefficients between typhoon scales and potential losses of the detail objects must need additional surveys.

OIL SPILL: A research program for valuating economic losses due to oil spills along the sea shore of Vietnam.

Five typical locations had been selected including: Nam Dinh (mangrove, aquatic feedings and cultivating); Quang Binh (fishing, salt producing); Da Nang (habitat, population health); Nha Trang (habitat, marine ecology systems); Ca Mau (inland water and river aquatic habitat, health, and non-use values). Similarly with the first and second program, this program is to collect primary data of actual losses in typical economic regions caused by oil spills and their consequences. Impacting coefficients between type and quantity of oil spills and potential losses of the detail objects must need additional surveys.

OTHER NECESSARY ACTIVITIES Regarding the educating function, we continue to focus on the followings:

- Strengthening international relationship to upgrade research skills and knowledge of COE' experts and researchers. Launching joint

researches with foreign and Vietnamese scientists to enrich experiences of the field.

- Accelerating process to set up the major of "economic loss valuation", forming relevant subjects and preparing text books for official lectured program.
- Continuing to strengthen the relationship between students and people, between education and practice in order to in time provide people with knowledge, attention and skills to mitigate the negative impacts and to adapt to the climate change, and also to learn from people's experiences.

In conclusion, Vietnam is recognized as one of the most vulnerable countries impacted by climate change. Besides challenges and difficulties we are going to face with, we acknowledge that this is also a chance for us to widen our international collaborations and encourage every effort to combat with negative effects of climate change in Vietnam as a pilot project in the world.

References

1. http://www.lenntech.com/greenhouse-effect/IPCC-SRES-scenarios-consequences.htm#ixzz0O7TSeOyQ.
2. Intergovernmental Panel on Climate change: http://www.ipcc.ch/
3. IPCC scenario presentations. http://www.ipcc.ch/present/graphics.htm
4. Mai Trong Nhuan, Responding and adapting to climate change, Nhandan Newspaper, August 2, 2009.
5. Nguoilaodong Newspaper May 18, 2008.
6. Sorrell, S., Emissions Trading After Kyoto. Introduction to Environmental Economics of Science and Technology Policy Research, 2004. [http://www.sussex/ http://www.sussex]. ac.uk /Users /prpp4/lec8.ppt
7. Trinh Cong Van, The Hydraulic Engineering Consultant Corp. 2.
8. Ursula Schaefer, Press from ADB.

CLIMATE CHANGE IMPACTS AND THE COMMUNITY-BASED CLIMATE CHANGE ADAPTION PROJECT IN THUA THIEN HUE PROVINCE

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Abstract

The purpose of this presentation is to introduce some problems in relation to climate change impacts in Thua Thien Hue province and some main contents about a current research project, namely; "Community-based adaptation to Climate Change and policy linkages in Thua Thien Hue Province", case study in Huong Tra and Quang Dien districts. Which has been implemented by IREB (the Institute of Environment, Resources and Biotechnology – Hue University) and supported by the Embassy of Finland.

Introduction

Developing countries are the most vulnerable to climate change impacts because they have fewer resources to adapt socially, technologically and financially. Climate change is anticipated to have far reaching effects on the sustainable development of developing countries, including their ability to attain the United Nations Millennium Development Goals by 2015' (UN, 2007). In Vietnam, a few studies on the impacts of climate change in the Central Coastal Zone have been initiated and some of them have been completed.

At local level, currently, most assessments of climate change impacts often have not yet gone beyond the assessment of losses, and the assessment of vulnerability to climate changes and capacity in climate change adaptation is still limited. Therefore, actions to adapt to climate change are and will depend on instructions, guidelines and warnings from central or other relevant agencies until such capacity is built up at local level. For this reason, there is an urgent need to develop climate change adaptation capacity in terms of human resources in localities. The community-based climate change adaption project will strengthen local scientific capacity through an interdisciplinary case study research project on the theme of climate change and adaptation, addressing both scientific and policy issues.

General introduction about Thua Thien Hue province

Thua Thien Hue is a province in coastal area of Northern Central Vietnam, limited in 15059' - 16048'N and 106025' - 107051'E, bordered with Quang Tri Province to the North, Da Nang City, Quang Nam Province to the South, The People's Democratic Republic of Laos to the West and the East Sea to the East.

Lying on the East – West corridor connecting Myanmar, Thailand, Laos, Viet Nam with the East Sea, Thua Thien Hue is one of four provinces of the key-point economic zone of the Central and one of the big cultural and tourism centers of the country.

Thua Thien Hue has an area of 5.054km^2, including 8 districts: Phong Dien, Quang Dien, Phu Vang, Huong Thuy, Huong Tra, Phu Loc, A Luoi, Nam Dong and Hue City with relatively complicated topography.

Some problems about Climate Change Impacts in Thua Thien Hue

According to the results of NCAP Project, Thua Thien Hue's climate has been significantly influenced by monsoon with associated characteristics, and it is divided into two main seasons; dry and rainy seasons.

The biggest change of rainfall with highest increase is occurring in rainy season (August to December), which contribute to a very high percentage to the annual rainfall. Meanwhile June-July's rainfall has obvious decreasing trend, which indicates a high risk of drought.

Temperature of all typical months and mean annual temperature in the studied period (1974-2004) have an increasing trend. The annual mean temperature would increase by 2.5-2.60 ^{0}C, but the increase is more significant in January and February (2.6-2.70 ^{0}C) than in hot months June and July (2.4-2.50 ^{0}C). In the high emission IPCC scenario (A1FI), the temperature would increase the most: by 3.90 ^{0}C, and in the Mar-May period even up to 4.7 ^{0}C by year 2100.

The best estimations of annual rainfall of Thua Thien Hue also show an increase of about 7%, but in dry season, it would decrease down to 10-15% (February to May). On the other hand, it would increase significantly in rainy season up to 10-24% (September to November).

In the "worst" case of high emission (A1FI), the rainfall of rainy season would increase by 25%, but in the first dry months of Dec-Feb, would decrease by -23%. The interesting fact is that the rainfall of dry months (Dec-Feb and Mar-May) decreases, which may cause very severe droughts.

The sea level rise in Thua Thien Hue would be about 57 cm in 2100 (with certain uncertainty as explained earlier), much less than in Northern and Southern part, but still have to be taken into account.

Due to increasing of temperature, the potential evaporation will increase respectively.

The very high rainfall which concentrates in some rainy months would increase the already high flood risk of this area, with all the adverse consequences, unless comprehensive adaptation measures are implemented.

The dry season would be longer and more severe, which would increase risk of droughts. The longer, severe droughts may adversely impact the energy generation in number of hydropower plants (under construction now or will be built soon) in Huong and other river of Thua Thien Hue, may threaten the municipal water supply for Hue city, irrigation for agriculture, cause fresh water shortage for down stream socio-economical and ecological systems. The salinization of surface and ground water and soil at coastal areas may adversely impact the agriculture, aquaculture and eco-tourism, as well as the unique ecosystems of wetlands, Tam Giang - Cau Hai lagoons. We can see that both the flood and the drought risk due to future climate change are very high for Thua Thien Hue.

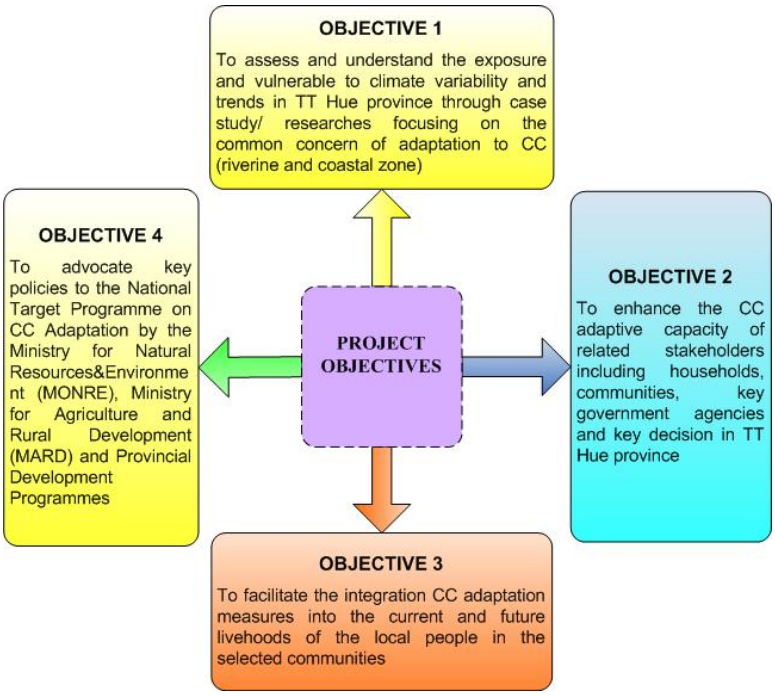

Figure 24: Project objectives

Introduction about the current research project implemented by IREB: FLC 09-04

General information

Project name: "Community based Adaptation to Climate Change and policy linkages in Thua Thien Hue Province"

- Project site: Case study in two communes (Quang Thanh and Huong Phong), of the two districts (Quang Dien and Huong Tra), Thua Thien Hue province.
- Supported by: the Embassy of Finland
- Duration: 7/2009 - 6/2011
- Implementation by: IREB, Hue University
- Total Budget: 100.000 Euros

Project description

This community-based climate change adaption project will provide scientific basis and understanding of the local perception of and adaption capacity to climate changes through case studies/researches in selected sites in one of the most highly vulnerable areas to climate changes in Vietnam - Thua Thien Hue province. This project is unique in terms of linking local issues and actions to policy development at local, provincial and national levels.

Project objectives

The project will have four objectives:

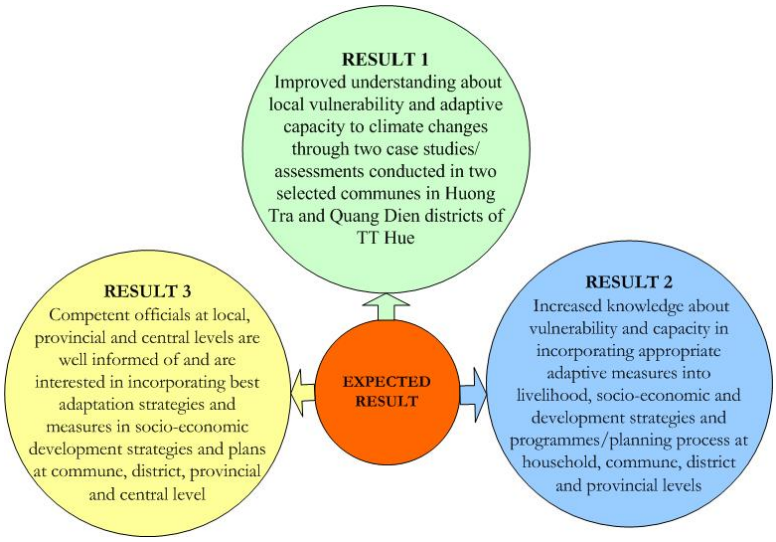

Figure 25: Project expected results

Project components

The project has three main components:
(1) Vulnerability and adaptive capacity assessments
(2) Awareness and training on adaptation, and
(3) Policy linkage and advocacy.
Each component has several planned interventions.

Project expected results, contents and Implementation plan

Key beneficiaries

Key beneficiaries of this adaptation project will be local people from two selected communes in the project, as well as decision makers from key government agencies in the province and the central level.

Conclusion

The most vulnerable to all types of impacts and dangers are always the poor people and special sensitive groups; the elders, the women and children. Many disaster casualties, especially from the floods and storms in Viet Nam are from the elders, women and children groups. In that case, they need very much well organized help and guidance, concrete and urgent measures from local, provincial and central authorities in relief and rescue works, after-disaster aid and recovery. Moreover, they need to be informed, early warned about the events, and good trainings for different types of impacts

The community-based climate change adaptation project above will focus on increasing awareness and capacity to adapt to the climate change mainly at local level and providing basis for climate change adaptation policy at national level. It will, therefore, aim to bring positive impacts on the social, economic and environment context. The project will make sure that there will be no negative impacts

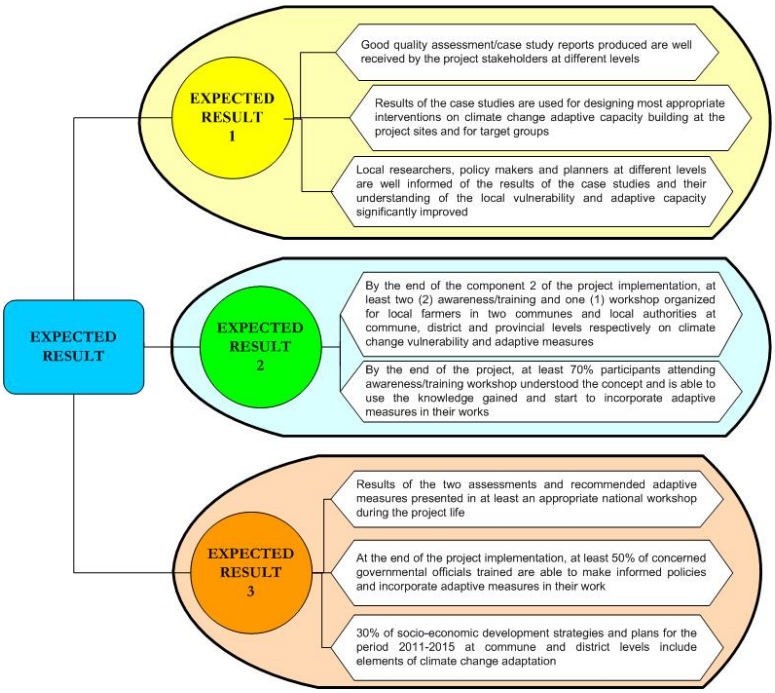

Figure 26: Project expected results in detail

that result from any climate change adaptive strategies and measures recommended.

The project aims at raising awareness on climate changes and building adaptive capacity for local people men and women, local communities, local authorities at commune, district and provincial levels. The people and governmental officials involved in the project activities and participating in the project workshops, hopefully, will form forces driving for making positive changes toward enhancing ability to successfully cope with climate changes in their current works and influencing the formulation of adaptive strategies and/or incorporating adaptive measures in socio-economic development strategies and plans. Therefore, it is expected that the project will continue to bring positive impacts into the future beyond the duration of the project implementation.

References

1. NCAP Project (2008). "Climate Change Impacts in Huong River Basin and Adaptation in its Coastal District Phu Vang, Thua Thien Hue province"

2. Institutes of Resources, Environment and Biotechnology-Hue University (IREB), Improving awareness on protection of air quality and understanding on global climate change, Hue, 26-28/06/2008

3. Le Van Thang (2008), "The Impacts of Climate Change on Environment of Thua Thien Hue Province", Workshop: Adapting to the Impact of Climate Change in Central Vietnam: Working towards a plan for action, Hue, 11/2008.

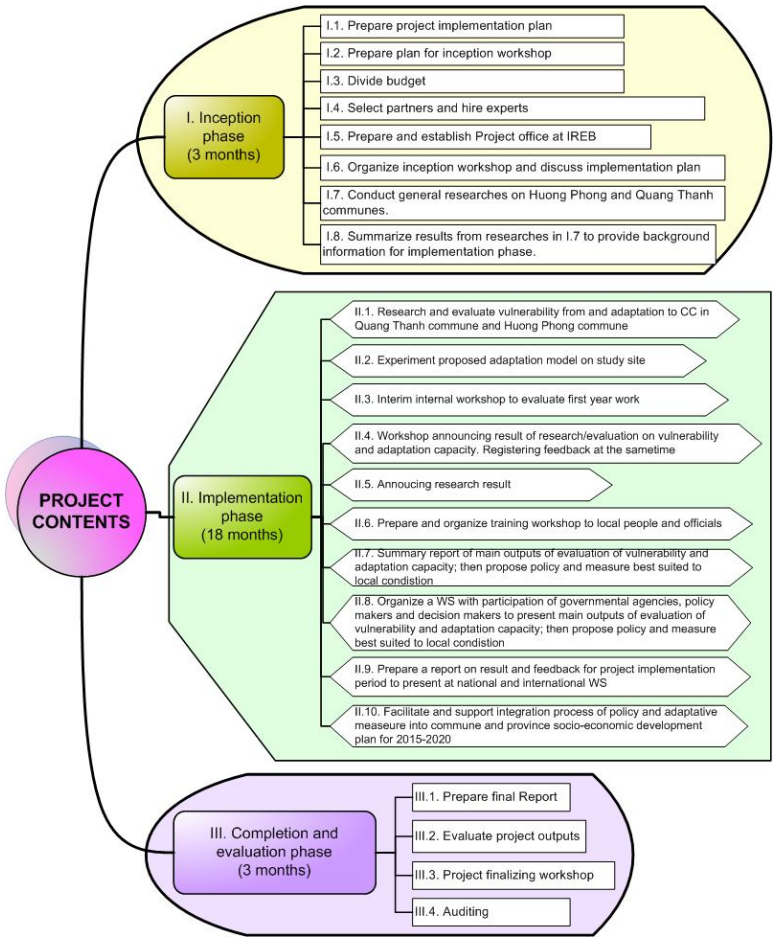

Figure 27: Project contents

No.	Activities	Year 1				Year 2			
		Q1	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*
0	**Inception Phase**								
I	***Component 1***								
	Vulnerability and adaptive capacity assessments								
II	***Component 2***								
	Awareness and training on adaptation								
III	***Component 3***								
	Policy linkage and advocacy								
IV	***Project management and other activities***								
	Prepare periodic progress technical and financial reports								
	organize coordination meeting with collaborating agencies	♦	♦	□	♦	□	♦	□	♦
	Mid-term Internal Review and workshop								
	External Final Review								
	End-project workshop								♦
	Audit								♦

Figure 28: Implementation plan

4. Le Van Thang (2008). The impact of climate change on agriculture and tourism of Thua Thien Hue province, Vietnam. The 8th General Seminar of the Core University Program. Environmental Science and Technology for the Earth. Osaka University and Vietnam National University, Hanoi. Page 166-172.

5. Le Van Thang. Strategies, policies and mitigations in air environment protection and climate change adaptation. Hue, 26-28/06/2008.

INFECTIOUS RISK ASSESSMENT WITH EXPOSURE TO PATHOGENS IN THE FLOOD WATER: PREDICTING THE EFFECT OF CLIMATE CHANGE

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Abstract

Prediction of the effect of extreme event caused by climate change has been studied in many areas. Flooding and inundation are common event caused by climate change in Asia, and known to give damage to properties and life for many people, especially poor people.

Metro Manila is the social, economic and political core of the Philippines. One of the most serious problems it encounters is the perennial flooding. Metro Manila area is in a tropical monsoon climatic zone, and the combination of typhoons and other climatic conditions with geographical factor of situating 0 meters above sea level causes frequent flooding. Further, rapid urbanization, poor capacity of river channels and drainage facilities, poor maintenance, growing informal settlers, institutional problems and financial restraints exacerbate the flood situation (JICA, 2001).

Many studies before presented evidences from a prospective epidemiologic microbiologic study that there are measurable health effects associated with swimming activities in contaminated surface waters. Cabelli (1982) reported that the swimming-associated illness was an acute, relatively benign gastroenteritis which had a short incubation period and duration. In the flood season, people may pose to a higher risk of infection with waterborne pathogenic than usual because of more frequent and intense contact with water that may have been severely polluted.

The purpose of this analysis was to characterize and quantify the human health risks associated with exposures to pathogen present in flood water in City of Manila. Exposure scenarios according to different inundation levels were developed in which direct and indirect contact with water was assumed to occur. Risk estimates for gastrointestinal infection for different groups of ages were based on established dose-response relationships for indicator pathogen (E. coli) to be present in the flood water. The probability of gastrointestinal illness due to E.Coli from incidental ingestion of flood water over the course of a year are 0.013398, 0.026556, 0.106796, and 0.187491 according to inundation levels of less than 50 cm, from 50-100 cm, from 100-200 cm, and above 200 cm, respectively. The risks for gastrointestinal illness reach the highest level in the group from 4 -15 year-old. The risk analysis suggests

that the contact with flood water poses significant human health risks for residents in the flood-prone region like Manila.

Key word: Risk assessment, inundation, gastrointestinal illness, City of Manila

References: JICA, 2001. Metro Manila Flood Control Project report.

CLIMATE AND ECOSYSTEMS CHANGE AND ITS ADAPTATION PROGRAMS IN KOREA

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Abstract

Climate and ecosystems change is the most pressing threat to the worldÕs environment, already contributing to visible impacts on human health, food security, economic activity, water and other natural resources, and physical infrastructure. It is very likely that most of this climate change in the current era is the result of human activities which have increased concentration of green house gases in the atmosphere and led the earth to warm. In this sense, decisive success for the climate change adaptation in the long run is dependent upon deepening knowledge, awareness raising and conviction of individuals and communities on the pivotal role of environment plays in human livelihoods. Therein lies the important role of higher education for deepening our knowledge of climate change impacts and assisting in the adaptation process.

There is growing evidence that Korea is vulnerable to the impacts of climate change. In the span of the last century average temperature has risen at more than twice the global average and annual rainfall and days with heavy rainfall have increased in the southern region of Korea. The change resulted in the more frequent storms and flooding events and the disruption of the ecosystem as seen in the early flower blossoms and changed in fish species. Moreover, frequent drought events are highly due to massive fluctuations in runoff each season by climate change. Therefore, comprehensive governmental countermeasure plans have been established and enforced four times in response to climate change since 1999, and research activities and higher educational programs for climate and ecosystems change adaptation in various sectors have been developed and being carried out. Apart from regular university degree programs on climate and ecosystems change, various special graduate school programs and short period education programs have been developed and under operation at the present.

However, universities will play crucial roles in building the ability to adapt to a changing climate, in particular, in choosing appropriate and practical adaptation educations that reduce the vulnerability of our settlements and infrastructure, natural ecosystems and water resources to the impacts of climate change. Universities have begun to take the issue of climate change more seriously. In response to climate change challenges, it is necessary to launch a new program for climate change adaptation aimed at assisting countries and communities to increase their adaptive capacity from the impacts of climate change. Thus, three major steps in addressing the current void in higher education and action are suggested: 1) integrating climate change issues into basic and higher education curriculum, 2) promoting innovative approaches of learning in formal and nonformal institutions, 3) highlighting and enhancing diffusion of appropriate technologies for adaptation and mitigation of climate change.

BEST PRACTICE AND CHALLENGES OF INTEGRATING EDUCATION, RESEARCH, AND COMMUNITY EMPOWERMENT FOR STRENGTHENING HIGHER EDUCATIONÕS ROLE IN CLIMATE CHANGE ADAPTATIONE CASE STUDY OF INDONESIA

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Abstract

Climate change needs to be addressed as a global issue. Indonesia, the fourth most populous nation of the world with 240 million people, is spread over a large archipelago in the tropical region comprising of more than 6000 inhabited islands. Climate change is threatening serious impact on Indonesia because of the particular geographical location and climate conditions of the country. The appropriate actions of concern that include local, national, regional and international level and building regional and international networks of various disciplines that allows sharing knowledge and experiences are important elements in addressing climate change issue. International cooperation can play an important role in addressing climate change adaptation. To promote effective/beneficial cooperation, there should be mutual understanding between developed and developing countries. For adapting to climate change, Indonesia proposed a series of programs. Indonesia made a commitment to cut energy sector emission by 17% by 2025 and implements strict reductions in forest burning. This commitment was announced in May 2008 and was greatly appreciated by international community. Transportation sector has also devised a *blue sky* program, to increase and improve public transportation in big cities in Indonesia. In addition, in order to respond in a more effective and active manner to climate change, integrating education, research and community empowerment will be an important approach to climate change adaptation.

Higher education institutions in Indonesia have three pillars: education, research and community services. All academic staff and students have an obligation to be involved in all of the three pillars. University of Gadjah Mada (UGM), the largest and oldest state-owned university in Indonesia, is very active in education, research and implementing community outreach programs and has adopted major efforts to enhance community participation. As such, implementation of climate change adaptation in UGM has become one of the most important components in research, community empowerment and academic area, and there are many successful examples of best practices relevant to climate change adaptation in the university. Through these research and practical activities, there have been an accumulation of rich experiences in community empowerment and network development in addressing climate change in terms of developing joint program/sandwich program/dual degree program at master level. It can also be recognized that community empowerment based on education and research is an important strategic approaches in addressing climate change. Thus, higher education should be able transfer and apply new knowledge and

experiences into the society, which will lead to sustainable adaptation initiatives by local communities.

3 GROUP DISCUSSIONS

Co-chaired by Prof. Kazuhiko Takeuchi, UNU-ISP and Prof. Mai Troung Nhuan, VNU Day 2 workshop began on 24 August and focused on the group discussion.

As introduction, Dr. Srikantha Herath of UNU-ISP gave an overview of UN-CECAR launched in the Tokyo workshop in June and expected outcome of the prospective academic network. He introduced the text of the Terms of Reference (TOR) of the network that has been developed during the two months since the June conference, incorporating feed back provided by the members of the network. The participants agreed on the final version of the text contained in the UN-CECAR brochure as the TOR for the network. Confirming the needs of degree program and research collaboration within the framework in the fields of climate and ecosystem change adaptation, the network acronym UN-CECAR was officially approved. Membership will be basically open to the universities and the other stakeholders in the region. The management of the network will be carried out by the International Coordinating Committee (ICC) comprising of the universities in the region. The activities will be guided and supported by advisory members who will be invited join the programs by UN-CECAR.

Two working groups, one focussing on the curriculum development and the other on joint research program development were designated in advance. Each working group was encouraged to discuss concrete activities plan and what to accomplish until the next workshop scheduled on 8-10 March 2010, to be held in Indonesia." "The parallel discussion among the two groups centred on (a) research and (b) curriculum development. The group members are listed in the Annex.

RESEARCH

Co-chaired by Prof. Herath, UNU-ISP and Prof. Tabios, the University of Philippines, the outline of the research program has been developed through active discussion, as follows:

Outline

1. Joint research program
2. Fund raising
3. Training for research
4. Knowledge hub
5. Dissemination
6. Outreach

Joint research program

In the research group, the first theme of discussion was about the establishment of a joint research program among UN-CECAR member

institutes and universities. Every participant of the research group has proposed their own interested focus area of climate change related disasters. In general, those proposed topic can be basically divided into two categories. One is disaster from extreme events related to climate change, which also can be called as fast change impact. For example, flood, typhoon and heavy snow are typical extreme events which are caused by rapid change of climate. Another one is disaster from long term impacts of climate change, which also can be considered as slow change impact. Such as drought, hydrologic cycle changes and temperature changes are the changes caused by long term impacts of climate change. Through the discussions, the joint research program was decided to focus on the analysis of the physical characteristics of the phenomena, impacts of disasters under social categories and mitigation strategy.

Specifically, in terms of physical characteristics of extreme events, participant have pointed out that estimation of potential maximum precipitation; analysis of the change of rainfall intensity, duration and frequency; investigation of path and magnitude of tropical cyclones; and heavy snow are main phenomena of rapid climate change disasters which require detail and in-depth research and study. Moreover, landscapes and ecosystems also should not be forgotten. Such as coastal systems, urban areas, agricultural and forests, they are also very important aspects related to this category, which need to be considered.

As for the impact of extreme events, they are generally related to these aspects, which include: flooding, ecosystems, agriculture, industry-timber, health, transportation and economy. The principal mitigation strategies that would be considered in response for the extreme disasters caused by rapid climate change are design standards of infrastructure, learning how to living with risks such as floods, the formulation and implementation of reforestation, development of early warning and evacuation systems.

On the other hand, it was agreed that the changing of landscapes and ecosystems caused by slow change of climate have been determined as major focus of long term climate and ecosystems change adaptation. Coastal systems, marine resources; urban areas; agricultural and forests are the main concern area in term of landscapes and ecosystems. The physical characteristics of them need to be studied and investigated in detail in order to establish more effective approaches and adaptation of climate change.

For the long-term effects of climate change, the impacts will be extensively reflected in many aspects of natural phenomena and social life. There are many areas which obviously will be highly influenced by slow climate change. They are considered as: water resources, agriculture, endangered species, protected areas, land cover, health, migration and economy. Therefore, the countermeasure to mitigate the long-term climate and ecosystems change impacts will be the long-term tracking of seasonal forecasts; improving governance to establish a better response systems and policies to climate change; applying indigenous knowledge and guidelines which adapted to local conditions; establishing and applying of practical strategy to protect livelihoods before disasters and constructively to help for the recovering after disasters.

Action Plan

After the joint research program objectives have been cleared in the group discussion, the following step was to formulate a working plan. Through the group discussions, a specific action plan has been decided as follows.

Firstly, according to the result of discussion on joint research program, at least one key institute will be designated to prepare capsule proposals for each determined research topic. The second step of action plan is to create a research project template which will be contributed to the proposal. As an example, a specific case study will be made as a module for teaching and applying. Furthermore, the key institutes will combine the idea from all member universities and institutes to define the research priorities and agenda from UN-CECAR. Finally, different types of proposals will be developed depending on donor specifications.

Knowledge Hub

There are many resources and ways can be used for the supporting of collaborated research. One way is to use Wiki, to create collaborative websites for the joint research program and to support the knowledge management systems. Furthermore, another effective way to support the joint research program is to link the existing knowledge repositories, such as UNU-INWEH database for GEF project or VNU (HCMC) database. In addition, DIAS (Data Integration and Analysis System of the University of Tokyo) can be also considered. Moreover, GEOSS (Global Earth Observation System of Systems), Sentinel Asia program of JAXA (Japan Aerospace Exploration Agency) also can provide tools and data for this kind of joint research.

Training Research

In order to set up an effective training system to support the joint research program, there are many possible ways to approach it. In the discussion, it was suggested that, on model and data use aspects, specialized training for faculty and training for researchers will be a practical way. In addition, to use existing programs which has been included in the research proposals and to use an event calendar in the Web Portal and email announcement to inform members will also be a good way for training the potential research members.

Dissemination

Except the joint research program activities, dissemination of the program also will play important role in the joint research. According to participants' suggestion, the following actions can be considered. First, research output can be used as case studies for the education programs; secondly, newsletter will be made and monthly rotating editors from among UN-CECAR. Finally, existing documents, manuals and articles will be uploaded.

Outreach

As agreed by everyone in the discussion, dissemination of the network activities can be carried out at many international events such as IHP (International Hydrologic Programme) in Wuhan in November 2009, COP15 in Copenhagen, COP10 in Nagoya and WWF (World Water Forum) in 2012 in Marseilles. They can be also an ideal opportunity to demonstrate UN-CECAR results. In addition UN-CECAR web server, a curriculum repository and a communication mechanism will be launched before the next meeting in March, 2010.

Funding

All participants have proposed some possible funding for the program. There are many potential donors who can support the joint research program such as; Global Environment Facility (GEF), Japan International Cooperation Agency (JICA) especially in relation to JST-JICA research framework, Korea International Cooperation Agency (KOICA), EU/EC (south-south cooperation), World Bank Disaster Risk Reduction Facility (south-south cooperation), AusAID and US Foundations (USAID, NSF, etc.)

CURRICULUM DEVELOPMENT

Prof. Janet Lindsay and Prof. Mai Troung Nhuan co-chaired the discussion session on curriculum development.

At the outset, Prof. Cu from the Vietnam National University, on behalf of the co-organizer presented a paper entitled "the Program for M.Sc. of climate change for sustainable development," based on the discussion in June to provide a discussion base. To initiate constructive discussion, he started from proposing a list of activities as follows:

1. Task force should be set up for gap analysis among participating universities, curriculum and address how to organize human resources including professors to develop prospective programs.
2. Trends of research and education system are quite different from country to country. Major trend in the field of climate change of each country should be also shared for further discussion toward platform building.
3. Many systems must be customized and contextualized to different universities and countries. Accreditation system, at least, should meet local needs to local university programs.
4. Assessment and gap analysis depending on countries should be carried out by the coming task force.
5. Securing funding resources is a must for the ambitious initiative, with possibilities of the World Bank, AUSID and JICA, so on.

He proposed two main degrees with a notion that the curriculum should benefit prospective career of students; Research Master degree for academia-oriented candidates and Professional Master degree for decision-makers those who would seek best solutions for climate change issues. He also noted challenges to be expected.

1. National needs remain unclear, survey such as training need assessment and gap analysis are required.
2. Whatever implemented in the future, the weight and priorities of each elements listed above have to be evaluated. UNU were recommended to take part in.
3. How to collaborate within the current network remains a difficulty.
4. Questions are raised related to physical, logistic, facilitation, and financial support that can be provided by UNU.

Based on the presentation to be followed by clarifications from the group participants, the Chair wrapped up the following topics to discuss:

1. What is the appropriate structure of suitable academic master program? Task force engaged in needs analysis and showing graduate program objectives, function of task forces (commitment), to be coordinated by UNU, should be established.
2. Barriers and opportunities due to cross-institutional and inter-countries,
3. Other forms of training course (training of trainers, e.g.): what kind of training provided should be clarified.

Group Proposal

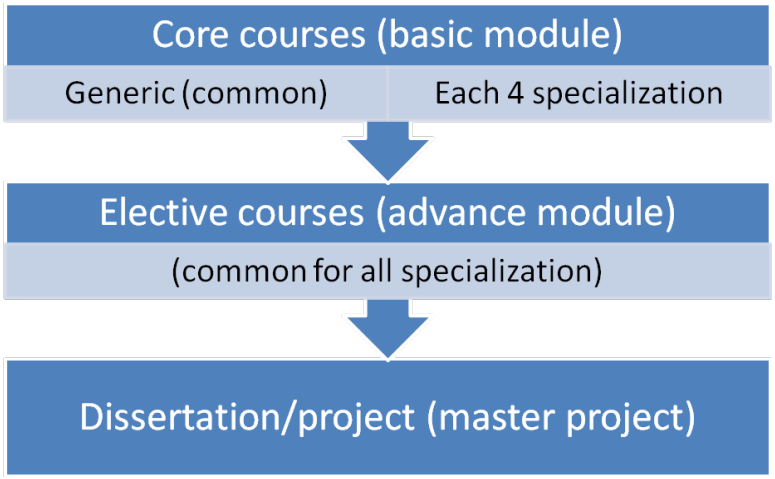
As discussed in Tokyo, element of flexibility is a must for a curriculum to adapt to local context. Recognizing dynamic process of climate change and evolving climate change adaptation, at the same time, the curricula need to be flexible while agreeing to basic principles. Thus, an overall framework, a combination of core course and elective course, jointly hosted by UNU and each national level was proposed and agreed.

Overall Structure

Overall structure of the master degree program is outlined as follows:

1. Title Masters in Climate Change (name to be decided)
2. Degree type: 4 kinds of specializations targeting research-oriented, policy, science and technology, and professional
3. Degree program is composed of three stages/levels/modules: (i) core courses, (ii) elective courses and (iii) dissertation/project.
4. Content structure
    a) Core courses
    b) Elective courses
    c) Dissertation
5. Duration (Pending)

6. Target Groups (Pending)



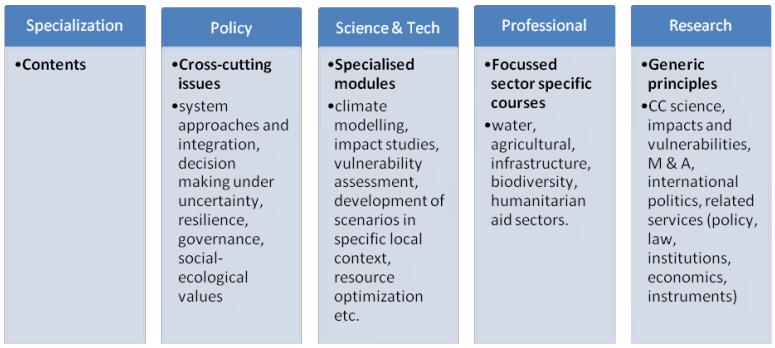
An example would be core courses provided at UNU (web material-based or physically gathered at Tokyo for the annual UNU International Course) and one year in Vietnam.

- Advantages

  "Modular" program is proposed instead of a flexible program to meet a variety of students' needs. With the modular system, students can start from diploma and transferring from diploma course to master will be possible, which can make the master course more flexible.

- Challenges

  It was opined that structure and mechanisms be separately discussed.



1. Degree Program

   Key Principle: Uniqueness

   a) Master degree
   b) Graduate Diploma
   c) Awarded by individual universities, not by UNU

2. Course structure

   a) Core courses

      i. Taken by all candidates

ii. Three course areas (see Table 1), jointly developed content by UN-CECAR
iii. Coordinated by UNU as node/clearing house
iv. Implemented at either UNU or national universities
v. Delivered via distance education or integration of the annual UNU International Course,

Note: This can be tailored for either graduate degrees or diploma.

b) Elective courses

Among large numbers of elective courses such as science, technology, hydrological and engineering, etc., students can decide which one to take. Modular program with elective courses will lead to specialized programmes suited to country's requirement either focusing on:

i. Research
ii. Policy
iii. Science
iv. Technology
v. Practitioner oriented courses (Professional courses (professional groups/consultancy oriented target groups)

Requirement: a Board to oversee the selection and development of electives.

c) Dissertation is a must for one semester four of four semesters: consists of mini thesis and full thesis, master's degree by research

CORE courses (Table 11)

As a part of the international master program, three core courses were discussed and confirmed based on the Tokyo discussion. In line with that, discussion moved on which core topics are to be covered under each course area.

Note: Professors from research group will join.

1. Advantages

   Course areas and core topics are structured in line with modular programs with room to be tailored to local needs depending on countries.

2. Challenges

   Having said that, local needs and capacities can be applied separately.

   International accreditation and course credit transfer, to be discussed separately.

Note:

- There can be a common elective program where top students can be brought together to participate (specialized courses run by UNU).

Area	Core topics	Focal points
Science of climate change	• Weather and climate • Forcing of Climate Change • Uncertainty • Sustainability Science	• Prof. Lindesay • Prof. Mohanty • Prof. Ratnayake • UNU-ISP
Impact and vulnerability	• Risk, Vulnerability and Resilience • Hazards and Disaster	• Prof Nhuan • Prof Ni • UNU-ISP
Adaptation and mitigation	• Climate Change and Sustainable Development • Community and Society • Governance (Planning, Policy, Law, Economics) • Communication and Capacity Building	• Prof. Cu • LESTARI • Prof. Shrestha • Prof. Tumiran • UNU-ISP

Table 11: Core areas and topics

Aspect/Area	Science	Technology	Policy	Professional
Core	40	40	40	40
Elective	30-40	30-40	30-40	30-40
Dissertation	20-30	20-30	20-30	20-30
Total	100%	100%	100%	100%

Table 12: Course and specialization

- Elective courses are drawn from University courses and can be cross institutional.
- UNECECAR as nuclear as node

1. Advantages
    - UNU-based course to bring top students from each university together for 4-6 weeks will serve to form global student network.
    - Dissertation research at another University or site supervised by a collaborating University will be smoothly processed/approved/provided.
2. Challenges to be discussed and clarified
    - Subject to a Board overseeing the distribution and weight age.
    - Funding and arrangements will have to be fleshed out.
    - 'Clearing House Mechanism' – databases (including activities) and interface systems to facilitate cross exchanges of information and material
    - How to share material and resource accessibility and transfer

Due to time constraint, elective course and dissertation have not fully yet discussed.

Training Courses

Recognizing the importance of policy maker's consensus to push education for climate change agenda as well as dynamic process of climate change/climate change adaptation, young and mid-career practitioners need to be educated. Thus, creating such training courses was proposed by utilizing/modifying/partially developing the master program. It is important to keep reasoning why we are developing curricula for whom we are delivering. One can start from "training of trainers" at university professors or teaching staff in the early stage. Considering prospective variety of targeting groups and potential users including non-academic sectors and practitioners, University can be a start and can be expanded to policy makers or others.

Outline (in phases):

EDUCATORS:

- Higher Education (Phase 1)
- Secondary (Phase 2)

OTHER POTENTIAL GROUPS (SUBJECT TO COUNTRY PRIORITIZATION)

- Key government stakeholders – Policy/decision makers, resource managers and planners
- Media

- Civil and Non-Governmental Based Organizations

Scale: regional based approach with collaborating institutions as nodes

Phase 1: High Level Course: Senior academics
Educators: Cascading concept from top to middle level academics

- Purpose – networking, information and engagement
- 1-5 days
- Focus group

Refresher courses: Middle level academics
Educators:

- Purpose – introduction/exposure/refresher to course and content
- 2-4 weeks
- Focus group – those conducting courses related to climate change

Proposal 1: pilot regional workshop
Regional Workshop: Capacity building in Higher Education for Adapting to Climate Change
5 day workshop and 1 day brainstorming
Target countries: India, Bangladesh, Nepal, Pakistan, Sri Lanka, Afghanistan, Bhutan and Maldives. Resource persons – drawn from UN-CECAR and local experts
Targeted date: February 2010 (before the next workshop to assess)
Location: India
Proposal 2: UN-CECAR regional training and workshop
4 weeks

Task Force (UN-CECAR)

1. Terms of Reference
    a) Core course development (3 groups, one for each area) with reference to target groups and existing programs/courses
    b) Institutional Arrangements (accreditation/transfers/badging etc) (University of Peradeniya Sri Lanma, Yeungnam University Korea, Tsinghua University, China, Gadja Mada University)
    c) Formalization of Master's program (UNU, Vietnam National University and Australian National University)
2. Work Program (UNU)
    a) Working time frame
    b) Activity Deadlines
    c) Reporting and Progress Review

Other discussion points and concerns raised

- There is a need to offer something that is unique, focusing on global needs, solutions and cooperation, is key, to establish a network, perhaps via a specific timed course to facilitate interactions and exchanges. For example, student exchange is possible with credit sharing and recognition of courses offered among network partners in an acceptable manner.
- There is a need to determine whether the core programme is anchored in one University, then an identifiable programme is possible. But if it is 'decentralised' then a suite of smaller modules is preferable – based on country requirement.
  - An international Master's programme with some common core course limited in number where the material will be offered via UNU, and the rest of the courses (not offered via UNU) in collaboration with other Universities (if relevant) will be developed by the Universities concerned.
  - There are possibilities for modules to be developed by Universities and channelled through the UNU and offered via UNU to be shared by and with other Universities.
  - If modules are not available, then *core modules can be developed and adapted to suit country needs. This is dependent on material availability and programme 'kick off' time for the country, as well as structure of teaching, whether it is dependent on practical training.*
- Deciding on alternatives is dependent on country particularities, but there is a need for a consolidated/common core module, then the elective module is tailored at national/university level. It is important to establish who delivers the Degree.
  - For international accreditation there is a need to select what is needed. We need to have complementary sets of courses that can facilitate transfer of credits between Universities based on the name, content and assigned credit.
  - Resources are limited, there is a need for shared special climate change programme, consolidate the content, where the students are grouped for a particular duration then they finish the remainder of their course in the selected country or area of study.
  - It is important to periodically evaluate the courses and get them accredited through internationally recognized agencies or group of academics or experts.
- Training needs analysis (TNA) should be done, for which task force was suggested. UNU were requested to take responsibility by circulating questionnaire
- Possibility of writing textbooks on CCA by UN-CECAR.

ANNEX

WORKSHOP PROGRAM

August 22nd, 2009	Arrival of participants
1.00 p.m – 5.00 p.m	Check in
5.00 p.m – 6.00 p.m	Registration
August 22nd, 2009	
Morning	National Workshop on current research by universities in Vietnam on climate change adaptation
8.30 a.m –9.00 a.m	Presentation from VNU HCM on urban flooding
9.00 a.m – 9.30 a.m	Presentation from Institute of Hydrology, Meteorology and Environment on water
9.30 a.m – 10.00 a.m	Presentation from VNU HN on bio-diversity
10.00 a.m – 10.15 a.m	Tea and coffee break
10.15 a.m – 10.45 a.m	Presentation from Can Tho University on rice
10.45 a.m – 11.15 a.m	Presentation from Hue University on rainfall
11.15 a.m – 11.415 a.m	Discussion
12.00 - 1.30	Lunch time – buffet
Afternoon	International Workshop on "Role of Higher Education in adapting to climate and ecosystems change"
2.00 p.m – 2.30 p.m	Opening remark by H.E.Mr. Nguyen Thien Nhan (to be confirmed) - Welcome remark by VNU President - Welcome remark by UNU Vice-President, Prof. Kazuhiko Takeuchi
2.30 p.m – 3.00 p.m	Prof. Kensuke Fukushi, Integrated Research System for Sustainability Science (IR3S), The University of Tokyo Infectious Risk Assessment with Exposure to Pathogens in the Flood Water - Predicting the Effect of Climate Change

3.00 p.m – 3.30 p.m	Prof. Soontak Lee, President, International Association for Environment and Hydrology, Distinguished Professor, Yeungnam University, Korea Climate and Ecosystems Change and Its Adaptation Programs in Korea
3.30 p.m – 4.00 p.m	Tea and coffee break
4.00 p.m – 4.30 p.m	Prof. Ir. Tumiran, Head, Faculty of Engineering, Gadjah Mada University, Indonesia Best Practice and Challenges of Integrating Education, Research and Community Empowerment for strengthening Higher Education's Role in Climate Change Adaptation
4.30 p.m – 5.30 p.m	Discussion
7.00 p.m – 9.00 p.m	Welcoming Reception
August 24th, 2009	University Network for Climate and Ecosystems Adaptation UN-CECAR 1 (closed to public)
Morning	UN-CECAR Action Plan for the next two years
8.30am – 9.00am	Outline for break out discussion
9.00am – 10.30 am	Discussion in 2 working groups (Education and Research)
10:30am – 11:00	Tea and coffee break
11.00am – 11.30am	Discussion in 2 working groups (Education and Research)
11:30am – 12:00am	Plenary – summary of discussions
12.00am – 1.30pm	Lunch time – buffet
Afternoon	UN-CECAR 2
1.30pm – 3.30pm	UN-CECAR Action Plan
3.30pm – 4.00pm	Tea and coffee break
4.00pm. – 5.00pm	Adoption of action plan, framework and advisory members, UNU Associated Institution, next meeting
7.00pm – 9.00pm	Dinner
August 25th, 2009	Check out and Departure of participants

Vietnam National Conference on Climate Change Adaptation on the day 1 is organized as a component of "Comparative Studies of Development Strategies incorporating Impacts of Adaptation to Climate Change" research project funded by Mitsui Environmental Fund of Japan.

WORKSHOP PARTICIPANTS

Curriculum Development

1. Dhan Van Cu VNU, Vietnam
2. Sarah Aziz University of Kebangaan Malaysia
3. Janette Lindsay Australian National University, Australia
4. Uditha Ratnayake University of Pedadgniya, Sri Lanka
5. Mai Troung Nhuan VNU, Vietnam
6. Rabindra Nath Shrestha, Institute of Engineering, Nepal
7. Ir. Tumiran, Gadja Madah University, Indonesia
8. UC Mohanty CAS IIT, Dehli, India
9. Guangheng Ni, Tsinghua University, China
10. Shimako Takahashi, UNU

Research

1. Kensuke Fukushi, the University of Tokyo, Japan
2. Srikantha Herath, UNU
3. Bui Dai Dung, VNU
4. Le Anh Tuan, Can Tho University, Vietnam
5. Yi Wang, UNU
6. Digiang Li, Chinese Academy of Forestry
7. Guillermo Tabios III, University of the Philippines
8. Hoang Van Thang, CRES-VNU
9. MD.Mafizur Rahman, BUET, Bangladesh
10. Sontak Lee, Yeungnam University & IHES, Korea
11. Ho Thi Ngoc Hieu, Hue University

Presentations

CLIMATE CHANGE SCENARIOS FOR VIET NAM

Tran Thuc, Nguyen Van Thang, Hoang Duc Cuong, Tran Hong Thai
Vietnam Institute of Hydro-Meteorology and Environment

BỘ TÀI NGUYÊN VÀ MÔI TRƯỜNG

Kịch bản
BIẾN ĐỔI KHÍ HẬU, NƯỚC BIỂN DÂNG
CHO VIỆT NAM

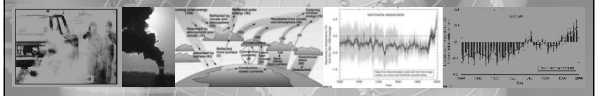
Hà Nội, tháng 6 - 2009

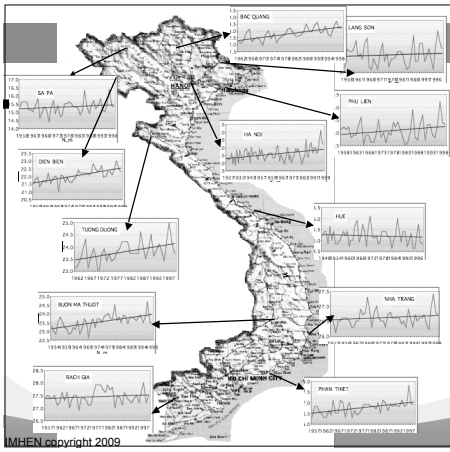
MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT

CLIMATE CHANGE, SEA LEVEL RISE SCENARIOS FOR VIET NAM

Hanoi, June - 2009

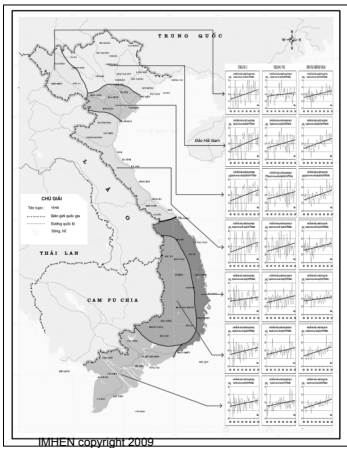
CLIMATE CHANGE IN VIET NAM





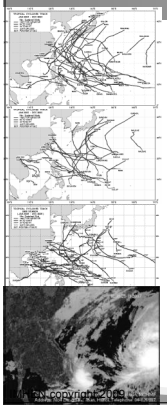
CC in Viet Nam: Temperature

Over the past 50 years, annual average temperature has increased about 0.5 to 0.7°C.



Averaged over Climate Region

Climate Change in Vietnam



More typhoon with high insensitive Typhoon trajectory moves southward and typhoon season shifts to later months of the year.

Cumulative tracks of tropical cyclones (1985–2005) [Nicholls et al.., 2007]

Climate Change in Vietnam

- Number of drizzle days decreases significantly;
- Frequency of cold front in the North decreases significantly in the past three decades: from 288 events (1971 -1980), 287 events (1981 – 1990), to 249 events (1991 – 2000);
- Number of extreme cold spell decreases. However, in some years it prolongs with historical insensitive, e.g. **in 2008**;

Climate Change in Vietnam

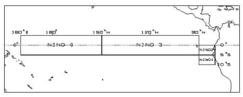
- Rainfall increases in rainy season (Sep. to Nov.)
- More heavy rainfalls causing severe floods which occur more frequently in the Central and Southern VN.
- Rainfall decreases in dry season (Jul., Aug.).
- Drought happen every year in most regions of the country.
- CC already caused severe natural disaster, especially typhoons, floods and droughts.

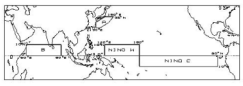
Climate Change in Vietnam

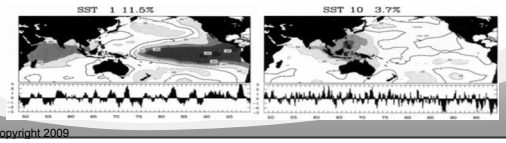
- Number of hot wave is more in 1991 - 2000, especially in the Central and South;
- Off-season extreme rainfall events occure more frequently. More profound are events in November in Ha Noi and surround in 1984, 1996, 2008.

Climate Change in Vietnam

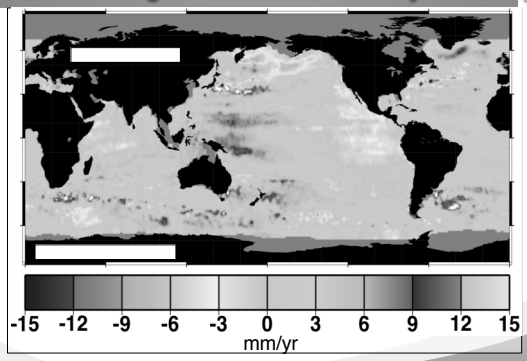
ENSO has stronger effects on weather and climate in Viet Nam





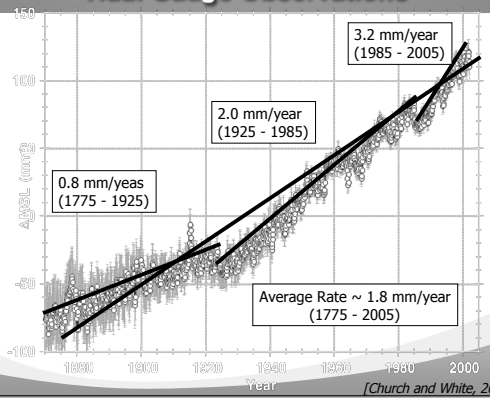


Sea Level Change is Not the Same Everywhere



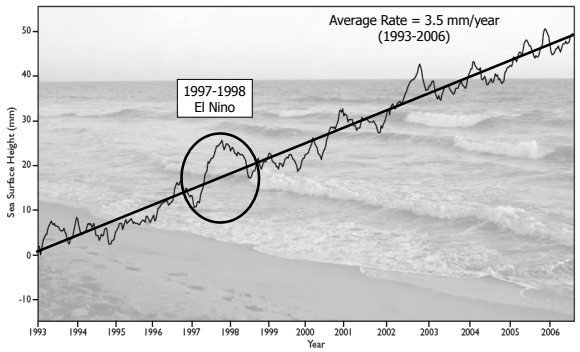
Average Sea Level Rise over 1993-2006

Tidal Gauge Observations



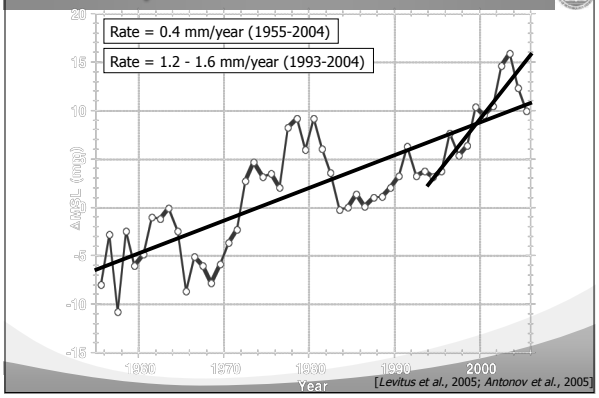
[Church and White, 2006]

Global Mean Sea Level from Satellite Altimetry



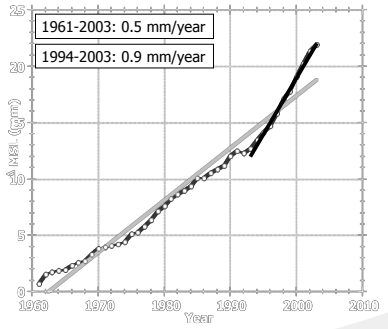
[Mitchum and Nerem, 2007]

Thermal Expansion: Contribution to Sea Level



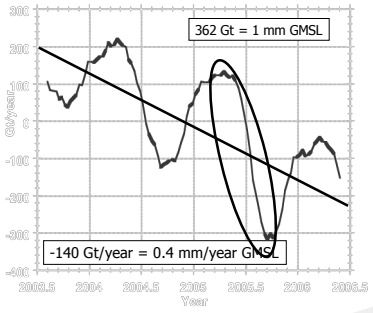
[*Levitus et al.*, 2005; *Antonov et al.*, 2005]

Mountain Glaciers: Contribution to Sea Level



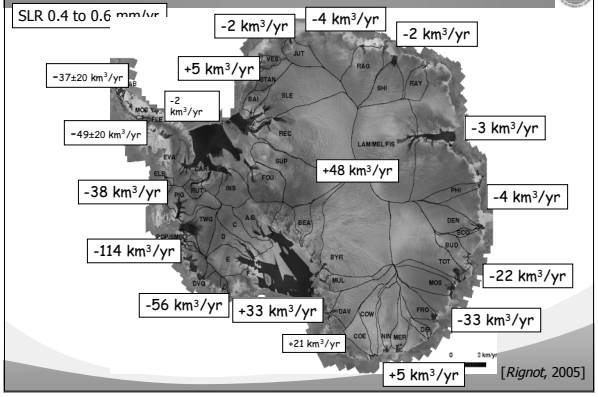
[*Dyurgerov and Meier*, 2005]

Greenland Ice Mass Loss from GRACE



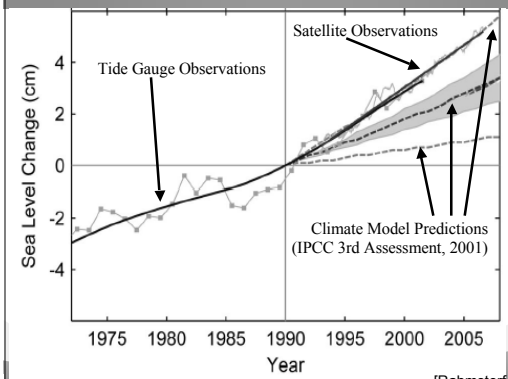
[Luthcke et al., 2006]

Antarctic Ice Mass Flux from InSAR



[*Rignot*, 2005]

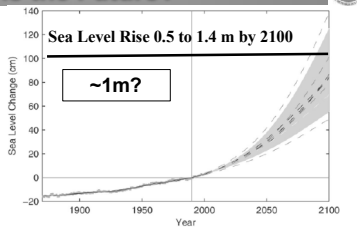
Sea Level Observations versus Predictions



[Rahmstorf et al., 2007]

How is the Future?

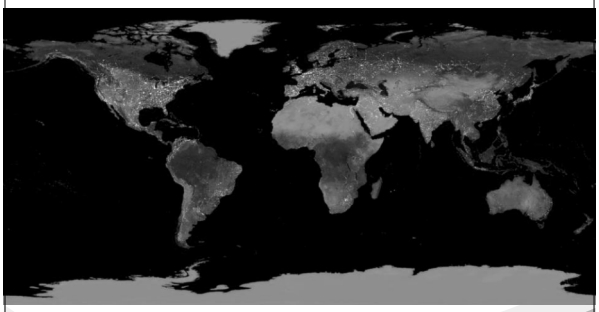
- IPCC 4th Assessment projects 0.28 - 0.59 m of SLR by 2100.



However, not all factors were included in these projections (most notably uncertainty surround how ice sheets would react to rising temperatures and interact with oceans) and are consequently too low.

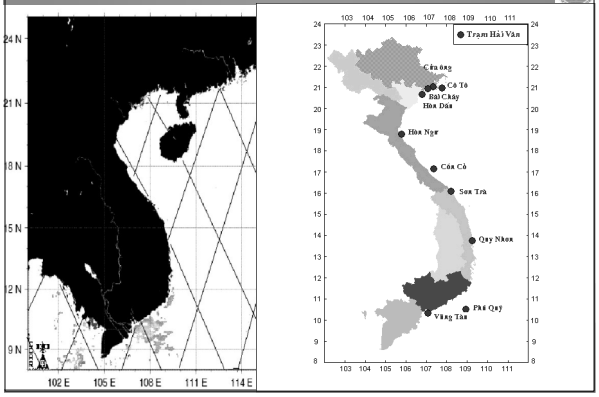
Recent study suggests higher rates: 0.5 - 1.4 m by 2100.

1 m Sea Level Rise



Vulnerable Area

Sea Water Measurement in Viet Nam

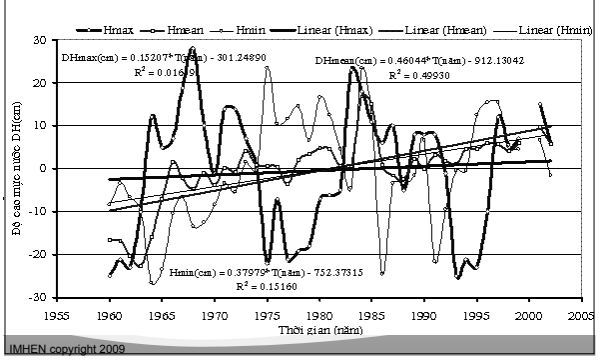


Tidal Gauge with more than 20 years of Records

No	Station	Latitude	Longitude	Record
1	Cua Ong	21°01’	107°21’	1961 - now
2	Co To	20°59’	107°46’	1958 - now
3	Bai Chay	20°57’	107°04’	1927 - now
4	Hon Dau	20°40’	106°48’	1960 - now
5	Hon Ngu	18°48’	105°46’	1962 - now
6	Con Co	17°10’	107°22’	1974 - now
7	Son Tra	16°06’	108°13’	1979 - now
8	Quy Nhon	13°46’	109°15’	1976 - now
9	Phu Quy	10°31’	108°56’	1979 - now
10	Vung Tau	10°20’	107°04’	1979 - now

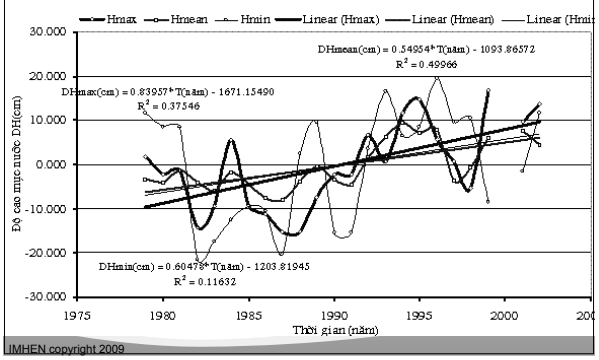
Observed Sea Water Level

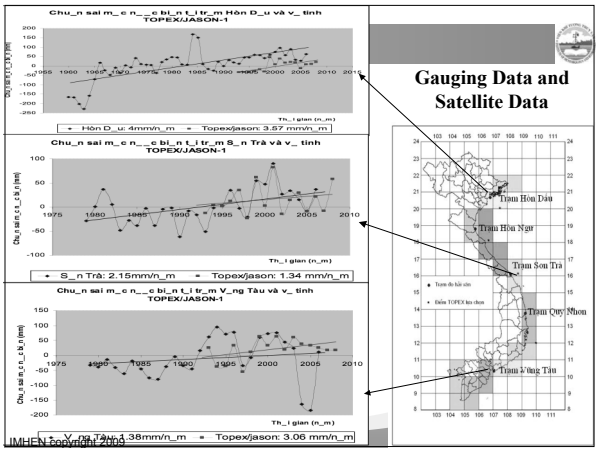
Hon Dau Station



Observed Sea Water Level

Vung Tau Station

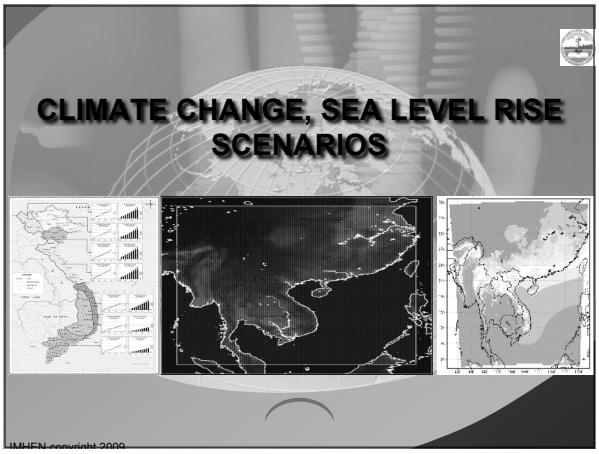




Sea Level Change

Based on OPEX và JASON-1 satellite data, 1993-2008

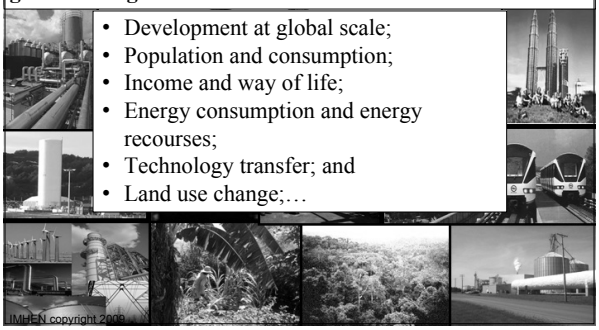
No	Station	Latitute	Longtutute	Period	Rate (mm/yr)
1	Hon Dau	20^0 - 21^0	106^0 - 107^0	1993 - 2008	3.6
2	Son Tra	16^0 - 17^0	108^0 - 109^0	1993 - 2008	1.3
3	Quy Nhon	13^0 - 14^0	109^0 - 110^0	1993 - 2008	3.8
4	Vung Tau	10^0 - 11^0	107^0 - 108^0	1993 - 2008	3.1
				Average	**3.0**



Targets set by the NTP

- ***"Complete CC scenarios, especially SLR, in Vietnam by early 2009 based on existing studies so that sectors and localities can use the scenarios to develop their action plans to respond to CC";***
- ***"By the end of 2010, update CC scenarios, especially SLR, for each period between 2010-2100. The scenarios must have a solid scientific and practical basis";***
- ***"By 2015, Update CC scenarios, especially SLR, in Vietnam".***

Human have emitted excessive greenhouse gas to the atmosphere through activities such as industry, agriculture, transportation, deforestation… hence, **the basis to greenhouse gas emission scenarios are:**



- Development at global scale;
- Population and consumption;
- Income and way of life;
- Energy consumption and energy recourses;
- Technology transfer; and
- Land use change;…

Greenhouse Gas Emission Scenarios

- **A1 family**: Rapid economic growth; Population reaches 19 bill. in 2005 then gradually declines; Quick spread of new and efficient technology; A convergent world-income, way of life converge between regions, Extensive social and cultural interactions worldwide:
  - A1FI: An emphasis on fossil fuels (high);
  - A1B: Balanced emphasis on all energy sources (medium);
  - A1T: Emphasis on non-fossil energy sources (low).
- **A2 family**: world of independently operation; Continuously increasing population; Regionally-oriented economic development; Slower and more fragmented technological changes and improvements to per capita income (high scenario, similar to A1FI).

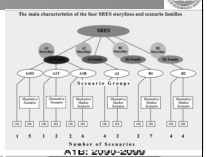
Greenhouse Gas Emission Scenarios

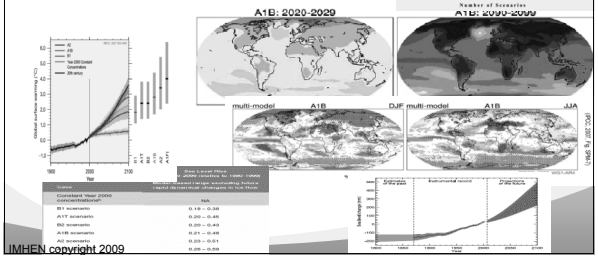
- **B1 family**: Rapid economic growth as in A1, but with rapid changes toward a service and information economy; Population rising to 9 billion in 2050 and then declining as in A1; Reductions in material intensive and the introduction of clean and resources efficient technologies; An emphasis on global solutions to economics, social and environment stability (low scenario, similar to A1T).
- **B2 family**: Continuously increasing population, but at a slower rate than in A2; Emphasis on local rather than global solutions to economic, social and environmental stability; Intermediate levels of economic development; Less rapid and more fragmented technological changes than in B1 and A1 (medium scenario, the same group of A1B).

Greenhouse Gas Emission Scenarios

IPCC recommended 6 groups:

- High emission scenarios: A1FI, A2
- Medium emission scenarios: B2, A1B
- Low emission scenarios: A1T, B1





Referrences for Development of CC, SLR for VN

Studies Oversea:

- The 2nd (1995), 3rd (2001), and 4th (2007) IPCC AR;
- Results from the global climate model (MRI-AGCM) with 20 km resolution from the Met Research Institute and Japan Department of Met;
- Report of CC scenario for Vietnam by research group of Oxford University, UK;
- Data from TOPEX / POSEIDON and JASON1 satellite;
- Studies on SLR: CSIRO; Proudman Oceanographic Laboratory, Univ. of Hawaii Sea Level Center;.....
- SLR scenarios in IPCC AR in 2001 and 2007;
- Reports on SLR from TIEMPO Climate Cyberlibrary

Referrences for Development of CC, SLR for VN

Study in Viet Nam:

1) CC scenario in 1994, project funded by ADB;
2) CC scenario for the VN Initial Communication to UNFCCC;
3) CC scenario by IMHEN by applying MAGICC/SCENGEN 4.1 software and statistical downscaling method for VN and other smaller regions;
4) CC scenario by (IMHEN) for the preparation of the VN Second Communication to UNFCCC;
5) CC scenario by IMHEN in 2008 by applying MAGICC/SCENGEN 5.3 software and statistical downscaling method;

Referrences for Development of CC, SLR for VN

Study in Viet Nam (Con't):

6) Results of study by IMHEN, SEA START and Hadley Centers in 2008 in applying PRECIS model to develop CC scenario for VN and SEA region;
7) Tidal gauge data along VN coasts;
8) Studies on SLR Marine Center, General Department of Sea and Island, MONRE;
9) SLR scenarios by IMHEN for the preparation of the VN Second Communication to UNFCCC

Method Used for Scenario Development

- Ensemble Global Climate Models (GCM)
- Dynamic Downscaling
  - Statistical Downscaling
  - MAGICC/SCENGEN soft wave
  - Others (chart, interpolation,...)

The statistical downscaling method analyze empirical data from weather stations and extrapolate the results into the future by using climate trend from the GCMs.

•Advantage: partly based on empirical local climate knowledge.

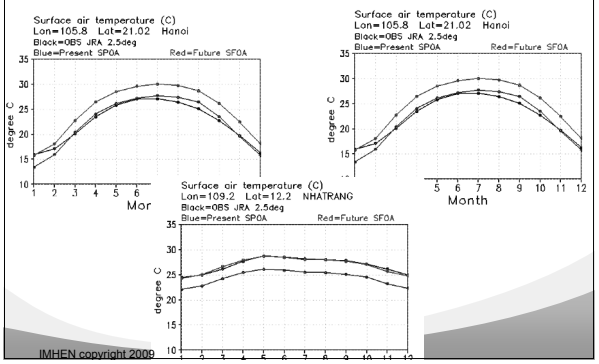
•Disadvantage: Availability of empirical data for long period without gaps.

Application of MRI/AGCM Model - Japan

Calibration:
- Stations used: 18
- Data: Monthly rainfall, temperature
- Period: 1979-2007

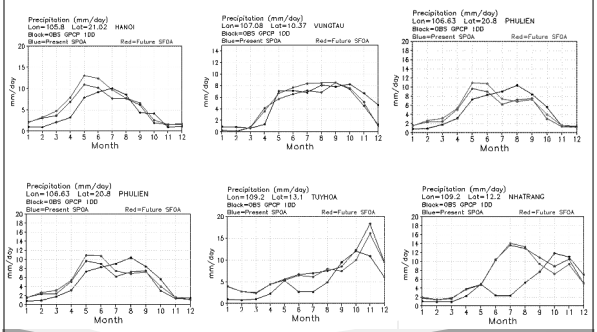
Application of MRI/AGCM Model - Japan

Comparison between Observed Data and Simulated Results: **Temperature**



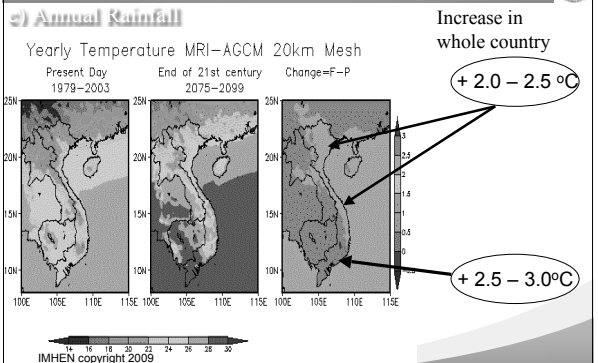
Application of MRI/AGCM Model - Japan

Comparison between Observed Data and Simulated Results: **Rainfall**



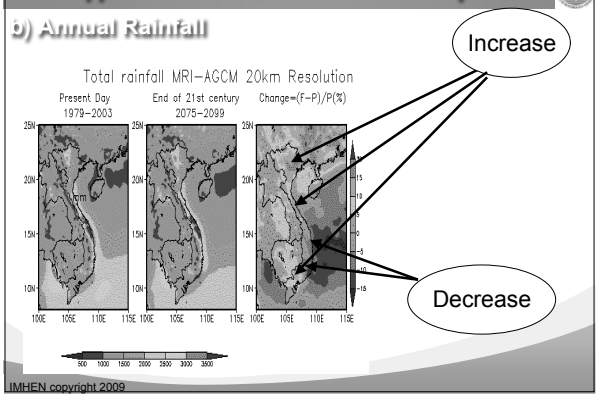
Application of MRI/AGCM Model - Japan

c) Annual Rainfall



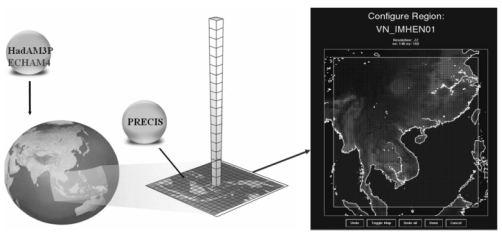
Application of MRI/AGCM Model - Japan

d) Annual Rainfall



Application of PRECIS model - Hadley Center, UK

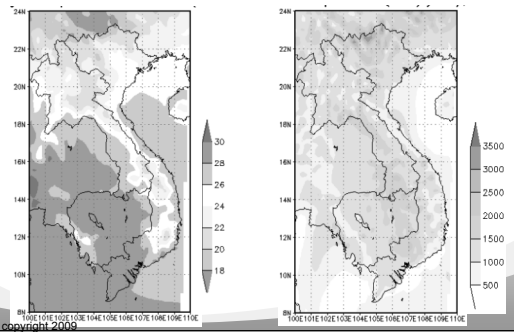
Computation Domain



Application of PRECIS model - Hadley Center, UK

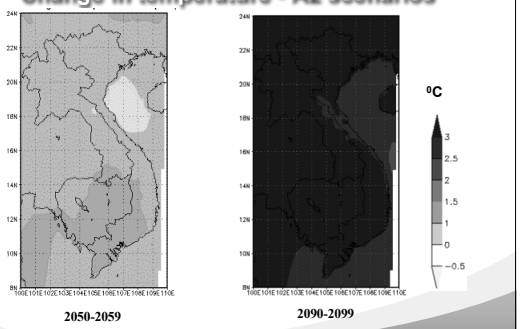
period 1980 – 1999

Temperature (^{0}C) Precipitation



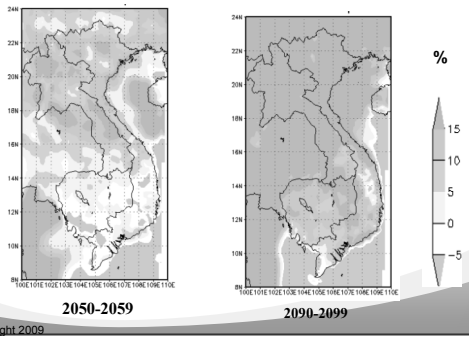
Application of PRECIS model - Hadley Center, UK

Change in temperature - A2 scenarios

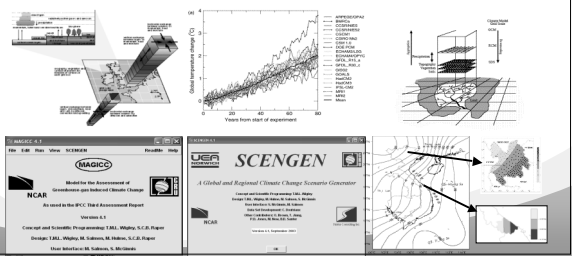


Application of PRECIS model - Hadley Center, UK

Change in precipitation - A2 scenario



Application of MAGICC/SCENGEN software and Statistical Downscaling Method



Criteria for selection of methods for CC scenario development

1) Credible level of global CC scenario;
2) Level of details of CC scenario;
3) Inheritance;
4) Up-to-date;
5) Regional appropriate;
6) Comprehension of scenario;
7) Possibility for Updating.

Climate Change Scenarios for Viet Nam

Three GHG emission scenarios used for CC scenarios development are:

- Low scenario (B1);
- Medium scenario of the Medium Emission Group (B2).;
- Medium scenario of the High Emission Group (A2).

CC scenarios for temperature and rainfall are developed for 7 climatic regions of Viet Nam: North West, North East, Northern Region, North of Central Region, South of Central Region, Central Highlands, and Southern Region. Baseline period is 1980-1999 (same as that of IPCC 4th Report).

Climate Change Scenarios for Viet Nam

1) Temperature

Increase of temperature in Winter is higher than that in Summer in all climatic regions. Temperature in the North increases faster than in the South.

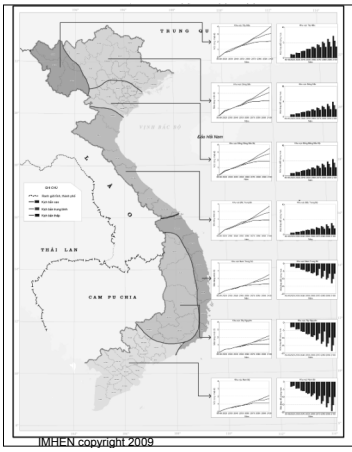
Changes in Annual Mean Temperature (°C) Relative to 1980-1999, Medium Scenario (B2)

Climatic Region	Decades in the 21 Century								
	2020	2030	2040	2050	2060	2070	2080	2090	2100
North West	0.5	0.7	1.0	1.3	1.6	1.9	2.1	2.4	2.6
North East	0.5	0.7	1.0	1.2	1.6	1.8	2.1	2.3	2.5
North Delta	0.5	0.7	0.9	1.2	1.5	1.8	2.0	2.2	2.4
North Central	0.5	0.8	1.1	1.5	1.8	2.1	2.4	2.6	2.8
South Central	0.4	0.5	0.7	0.9	1.2	1.4	1.6	1.8	1.9
Central Highlands	0.3	0.5	0.6	0.8	1.0	1.2	1.4	1.5	1.6
South	0.4	0.6	0.8	1.0	1.3	1.6	1.8	1.9	2.0

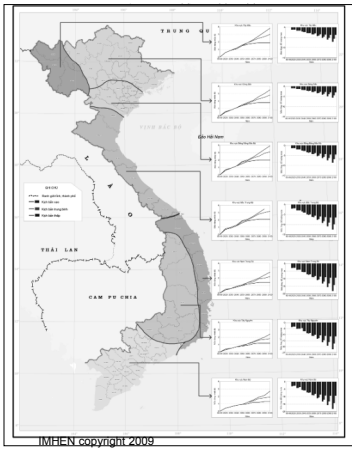
Climate Change Scenarios for Viet Nam

- **2) Rainfall**

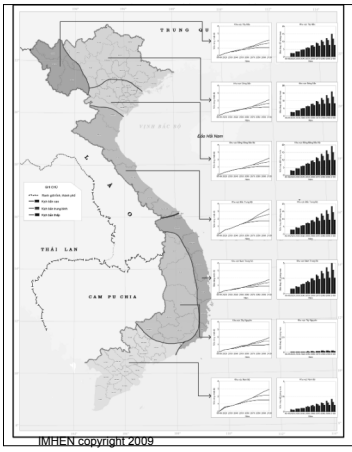
Rainfall in dry season decreases in all Regions, especially in the South. Rainfall in Wet season and annual rainfall increase.



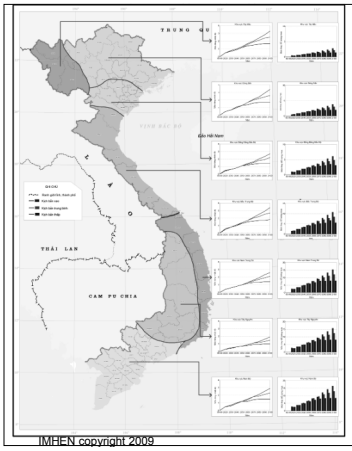
Changes in Temperature and Rainfall in **XII-II**
•Low scenario (B1),
•Medium scenario (B2),
•High scenario (A2)



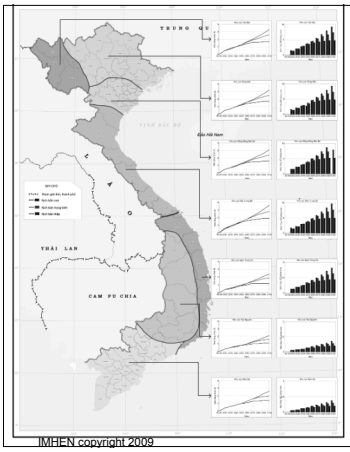
Changes in Temperature and Rainfall in **III -V**
•Low scenario (B1),
•Medium scenario (B2),
•High scenario (A2)



Changes in Temperature and Rainfall in **VI -VIII**
•Low scenario (B1),
•Medium scenario (B2),
•High scenario (A2)



Changes in Temperature and Rainfall in **IX-VI**
- Low scenario (B1),
- Medium scenario (B2),
- High scenario (A2)



Changes in **Annual Mean** Temperature and rainfall
- Low scenario (B1),
- Medium scenario (B2),
- High scenario (A2)

Sea Level Rise Scenarios

SLR scenarios:
- Low Scenario: B1
- Medium Scenarios: B2
- High Scenarios: A1FI

SLR Scenario	Decades in the 21 Century								
	2020	2030	2040	**2050**	2060	2070	2080	2090	**2100**
Low (B1)	11	17	23	**28**	35	42	50	57	**65**
Medium (B2)	12	17	23	**30**	37	46	54	64	**75**
High (A1FI)	12	17	24	**33**	44	57	71	86	**100**

CONCLUSIONS

1) CC, SLR scenarios for VN are developed basing on different emission scenarios: low (B1), medium (B2), and high (A2, A1FI).
2) Low scenarios (B1) describes the world with low emission: changes toward a service and information economy, low population growth, clean and resources efficient technologies; global solutions to economics, social and environment stability.

   However, with a current convergent world economy, different views between the developed and developing countries, difficulties in negotiation in limiting temperature increase to 2^{o}C, low emission scenario does not seem to be possible for the 21st century.

CONCLUSIONS

3) High scenarios (A2, A1FI) describes the world with high emission, independently operation, self-reliant nations; Continuously increasing population, regionally-oriented economic development, slower and more fragmented technological changes and improvements to per capita income (A2); or extensive use of fossil fuels (A1FI).

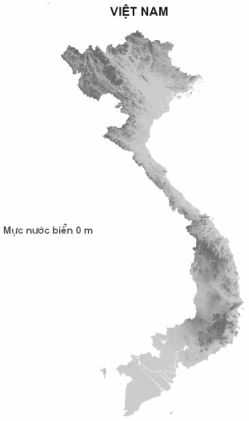
   These are the worst scenarios we can imagine. With the development of new and climate friendly technology, affords in negotiation in greenhouse gas reduction, the world's campaign in "combating CC", we can hope that the high scenarios will not happen.

CONCLUSIONS

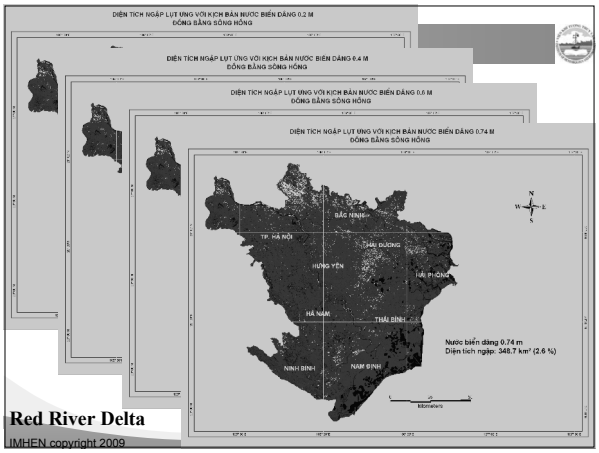
4) Moreover, there are uncertainties in construction socio-economic development scenarios, hence greenhouse gas emission in the future. Apparently, when there are uncertainties, then CC and SLR scenarios that lie in the upper or lower limits have a lower level of confidence that that of the medium one.
5) Due to the complexity of CC and limitation of our knowledge in CC, both in VN and in the world, together with the consideration of mentality, economy, uncertainty in green house gas emission ..., the medium scenario is, therefore, harmonious and recommended for CC impacts assessment and action plan development.

CONCLUSIONS

6) Results still contain uncertainties due to: (i) Low level of affirmation of emission scenarios; (ii) Certain error of model in simulating for a very long period; (iii) Certain error in the downscaling method basing on global and regional results; (iv) Uneven distribution of climatic factors in space.
7) IPCC recommended applying tolerance, e.g., a tolerance for temperature by the end of 21st century: 0.4 - 0.6^{o}C; annual rainfall: 1 - 2%, monthly rainfall: 5% . Moreover, scenarios must be frequently updated in data, knowledge, computing model, and method of computation.
8) CC, SLR scenarios for VN will be updated following the roadmap decided in the NTP.

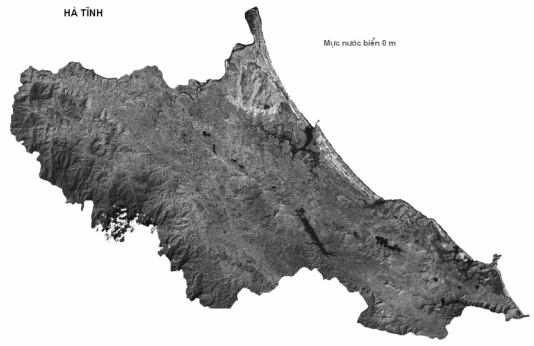


The inundation maps are constructed based only on topographic maps, other aspects such as effects of tide, wave, storm surge, flow from rivers and other dynamic effects are not yet considered.

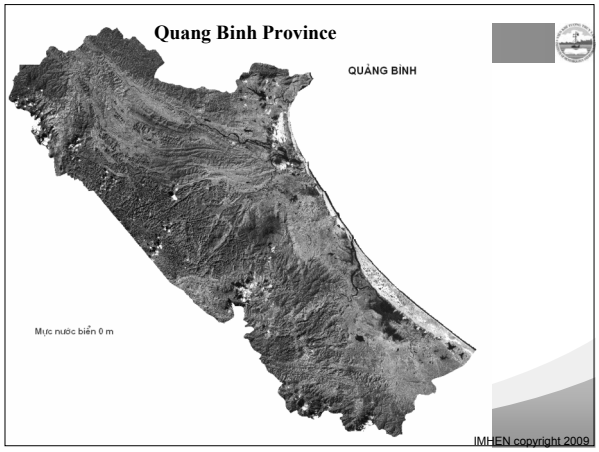


Red River Delta

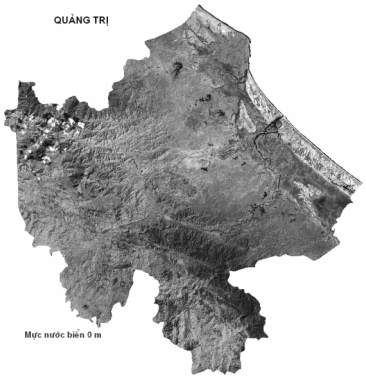
Ha Tinh Province



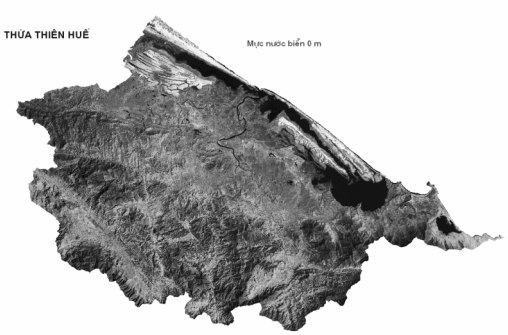
Quang Binh Province



Quang Tri Province

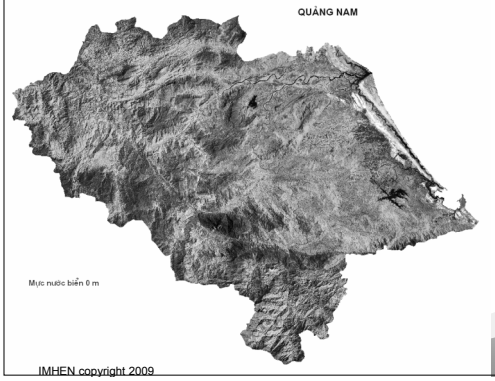


Thua Thien Hue Province

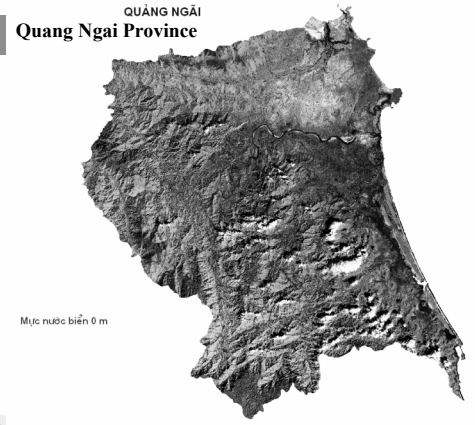


Da Nang City

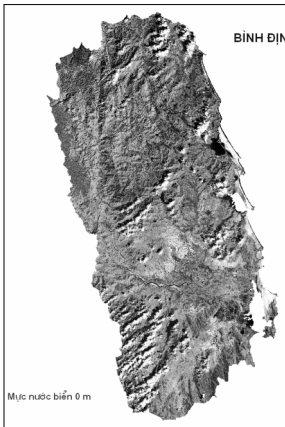
Quang Nam Province



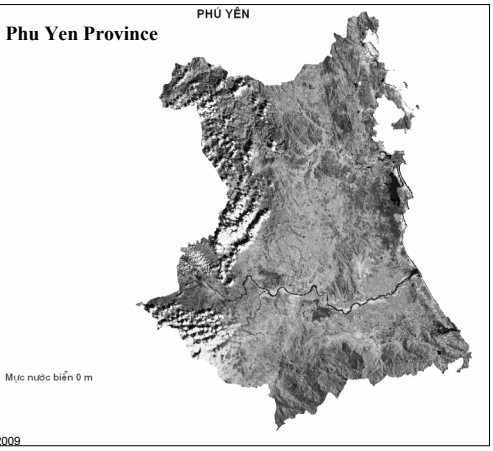
Quang Ngai Province

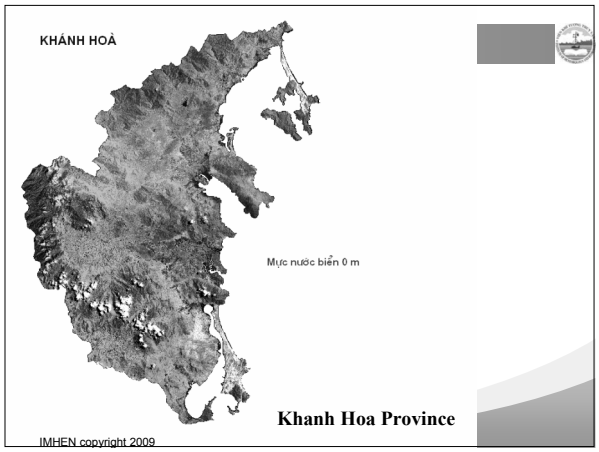


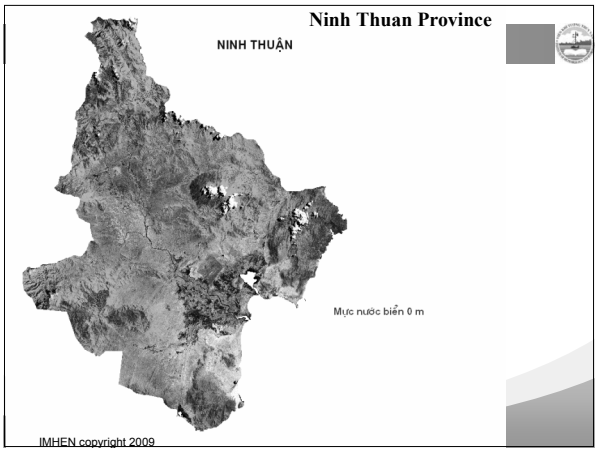
Binh Dinh Province

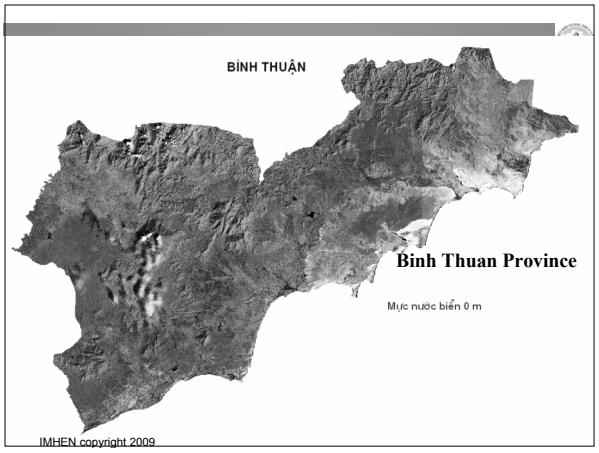


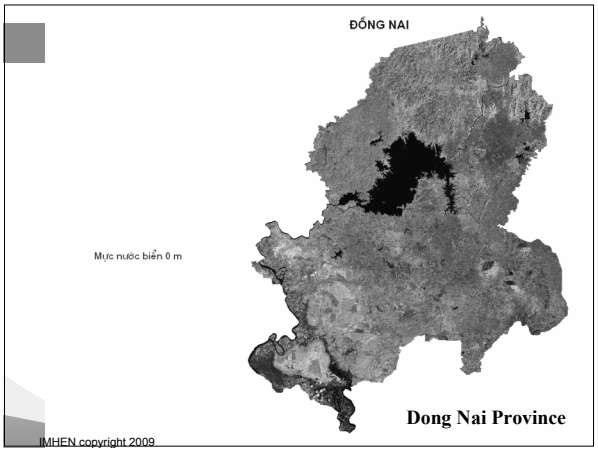
Phu Yen Province

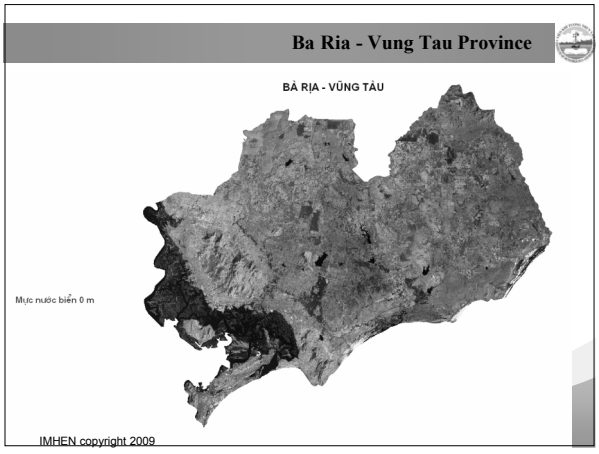


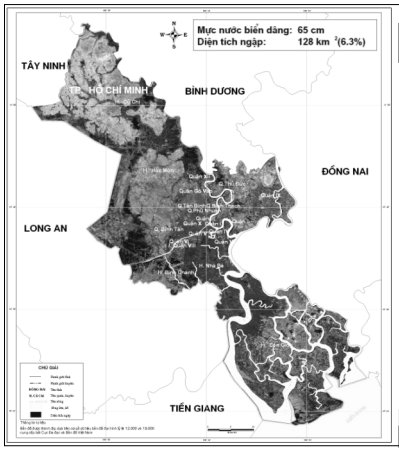








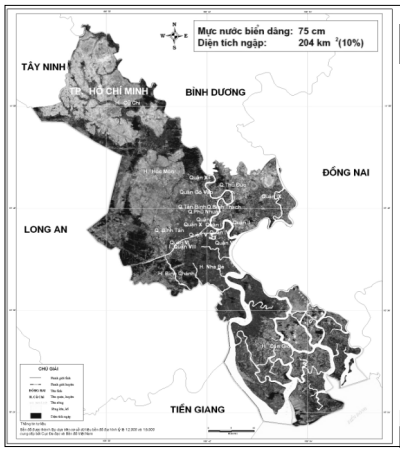




Inundation Map of Ho Chi Minh City Area

SLR:	0.65 m
Inundated:	128 km^2 (6.3%)

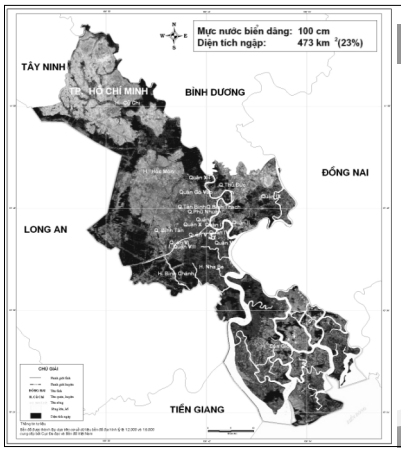
- *Based on Topographic Map Scaled 1/2.000 and 1/5.000*
- *Sources: Department of Survey and Mapping , MONRE*



Inundation Map of Ho Chi Minh City Area

SLR: 0.75 m
Inundation: 204 km^2 (10%)

- *Based on Topographic Map Scaled 1/2.000 and 1/5.000*
- *Sources: Department of Survey and Mapping , MONRE*

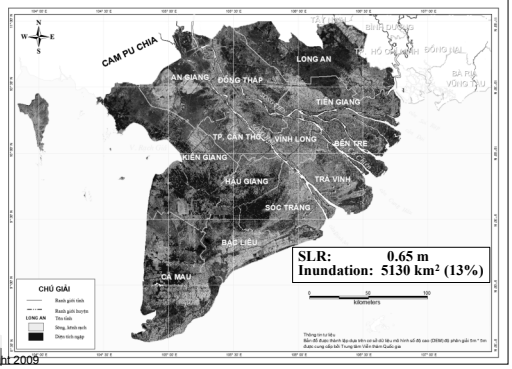


Inundation Map of Ho Chi Minh City Area

SLR: 1.0 m
Inundation: 473 km^2 (23%)

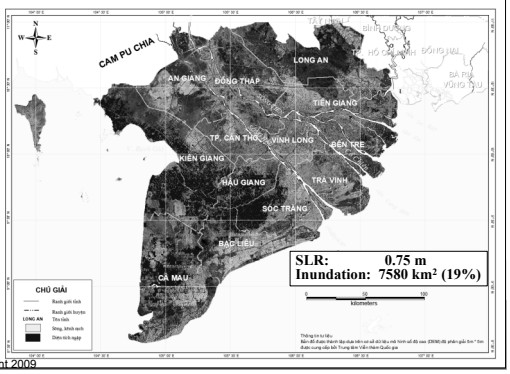
- *Based on Topographic Map Scaled 1/2.000 and 1/5.000*
- *Sources: Department of Survey and Mapping , MONRE*

Inundation Map of Mekong River Delta, SLR 0.65 m



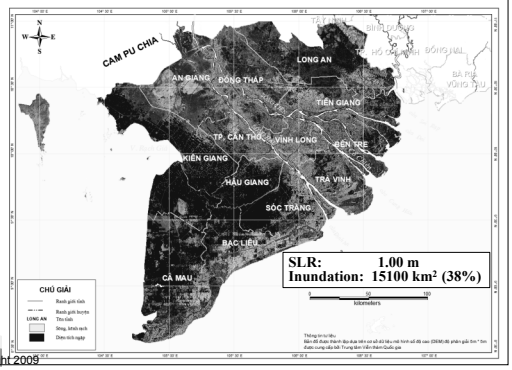
Basing on DEM (5 x 5 km) Provided by National Remote Sensing Center, MONRE

Inundation Map of Mekong River Delta, SLR 0.75 m



Basing on DEM (5 x 5 km) Provided by National Remote Sensing Center, MONRE

Inundation Map of Mekong River Delta, SLR 1.0 m



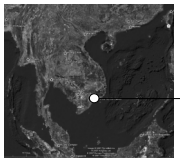
Basing on DEM (5 x 5 m) Provided by National Remote Sensing Center, MONRE

LOCAL CLIMATE CHANGES
in HO CHI MINH CITY:
A STATISTICAL ANALYSIS

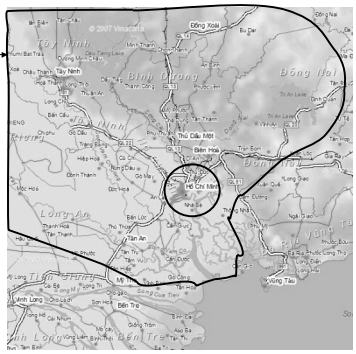
Ho Long Phi
Vietnam National University
Ho Chi Minh City, Viet Nam

URBANISATION

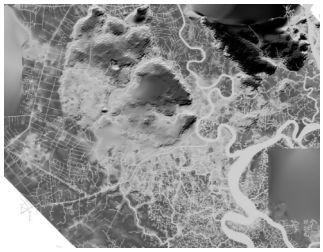
STUDIED AREA



The most important part of HCM is about 2000 km², related catchment is much larger.



Topography



Highest elv.: +34 m

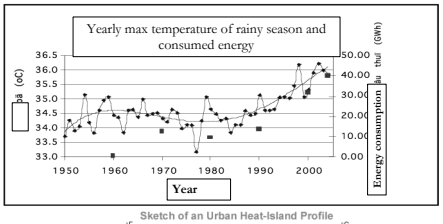
Lowest Elev.: 0.5 m

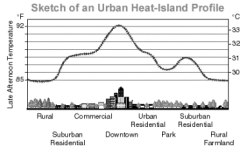
Current max tide level: +1.55 m

60% of studied area is below +1.5 m

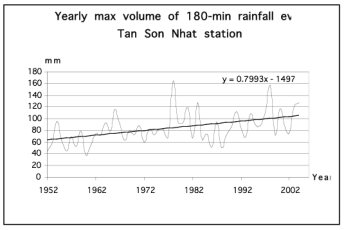
LOCAL CLIMATE CHANGES

Urban temperature





Rainfall



Counts of 3-hour rainfall events with volume >100mm

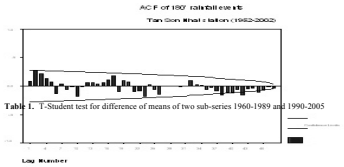
Period	1952-1961	1962-1971	1972-1981	1982-1991	1992-2002
Counts	0	1	2	2	4

Statistical test

Trend analysis of yearly max rainfall volume of a single event at Tan Son Nhat station

Rmax (mm)	n	Mann-Kendall Z	Signific.	Sen's Q	Sen's B	COV	Remark
Tan Son Nhat	*57*	*3.88*	*99.9%*	*0.739*	*62.172*	*0.31*	*Strong rise*

Tests of increasing trend



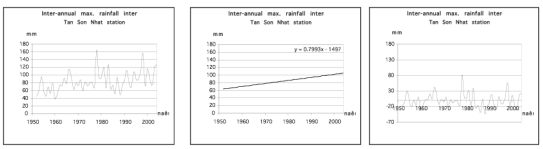
- **Auto-Correlation Function Test shows non-stationary property of data.**
- **Rate of change is about 0.8mm per year.**

Non-stationary time series

- Value of Return Frequency P may change with time.
- Conventional method is no more valid.

Additive Approach

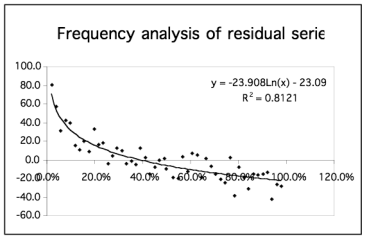
- **Step 1:**
  - **Decomposition of data serie into its trend A(year) and residual serie B(frequency).**



Real data (P,T) = Trend A(t) + Residue B(p)

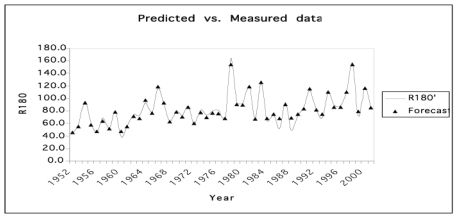
Additive Approach

- **Step 2:**
  - **Calculation of frequency for the residue serie B(p).**



Additive Approach

- Step 3:
  - Time series will be re-integrated for a particular time and frequency A(t) + B(p)



Rainfall Volume Projection

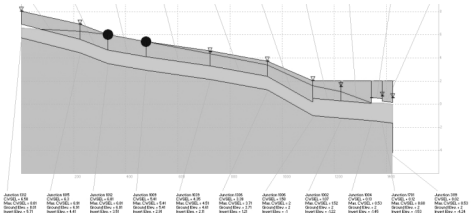
Return Frequency (year)	100	50	20	10	5	3	2	1
Conventional method	164.5	150.2	131.0	116.2	105.8	88.5	77.5	41.2
Non-stationary Additive method	186.7	179.1	160.3	139.5	121.2	113.6	103.7	61.6
Projection for 2020	200.2	192.7	173.8	153.0	134.7	127.1	117.2	75.1

Current use

Non-stationary method

NS method projection to 2020

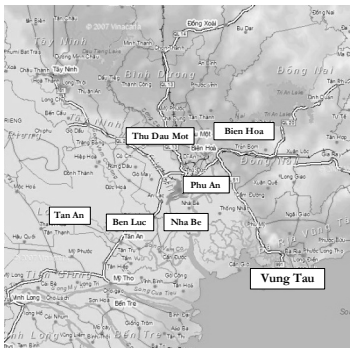
Sewer surcharge



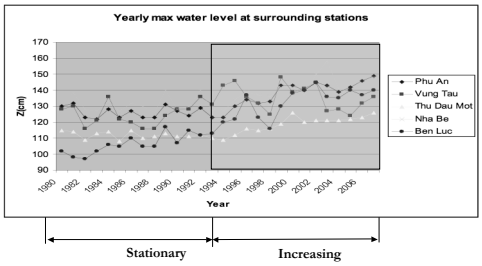
- Insufficient capacity of sewer may return in surcharge in future.

WATER LEVEL

Surrounding hydrological stations

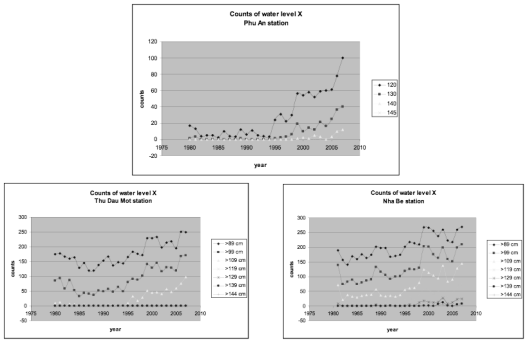


Water level at lower boundaries

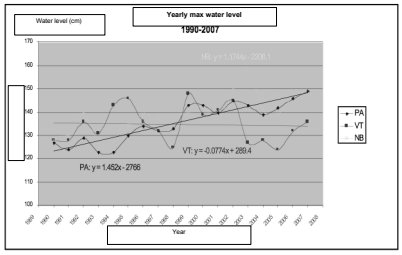


T-Student tests confirm the statistically difference between means of two sub-series 1960-1989 and 1990-2009.

Counts of exceeding levels



Evidences of local trends in water level rise



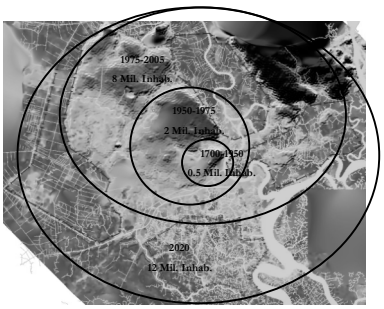
- **Sea level at Vung Tau (red line) has been hardly changed, while all water levels at river stations has shown an average increasing of 1.5cm per year since 1990.**

Statistical analysis of trend

Table 1: Trend analysis of yearly max water level at main stations

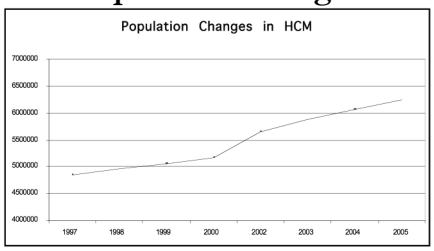
Zmax (cm)	n	Mann-Kendall Z	Signific.	Sen's Q	Sen's B	COV	Remark
Phu An	*18*	*4.03*	***	*1.455*	*108.82*	*0.06*	*Strong rise*
Vung Tàu	*18*	*-0.04*		*0.000*	*134.00*	*0.06*	*No change*
Thu Dau Mot	*18*	*4.46*	***	*0.900*	*100.70*	*0.05*	*Strong rise*
Nha Be	*18*	*3.27*	**	*1.167*	*116.58*	*0.06*	*Strong rise*
Bien Hoa	*18*	*1.86*	+	*1.800*	*138.30*	*0.11*	*Weak rise*
Ben Luc	*18*	*3.88*	***	*1.917*	*92.00*	*0.09*	*Strong rise*
Tan An	*18*	*2.88*	**	*1.941*	*97.76*	*0.12*	*Strong rise*

Urbanisation



New urbanised areas have been developed on lowland since the last decade.

Population changes

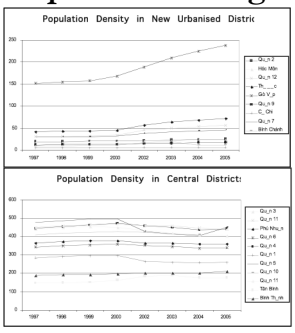


Source: Statistical Office in HCM City

http://www.pso.hochiminhcity.gov.vn/so_lieu_ktxh/view_content_year?ID=Dan_so_va_lao_dong&parent_ID=2004

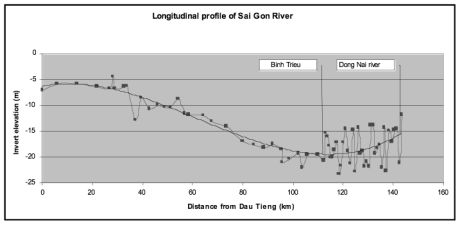
Immigration grows rapidly since 2000, coincident with economical boom of the city.

Population changes



Population grows mostly in new urbanised districts whereas decreased or remained unchanged in central areas of the city.

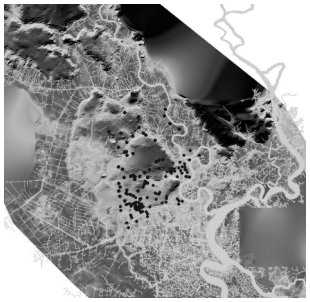
Drainage capacity of Saigon river



Sai Gon river is currently under unfavorable conditions, which reduce flow capacity remarkably.

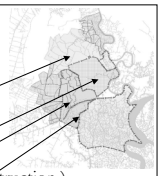
INUNDATION

Inundation situations



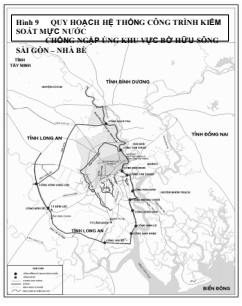
More than 100 locations is reported flooded repeatedly by heavy rainfall and/or tide.

Urban Drainage Projects



- Master plan JICA (6/2001)
- Tham Luong-Ben Cat (USD 400 Mil., under construction)
- Nhieu Loc-Thi Nghe (USD 150 Mil., under construction)
- Tan Hoa-Lo Gom (USD 200 Mil., under design)
- Tau Hu – Ben Nghe (USD 250 Mil., under construction)
- Hundreds of small projects since 1990.
- USD 4 Bil. is required for the next 15 years.

Tide Control Project (MARD)

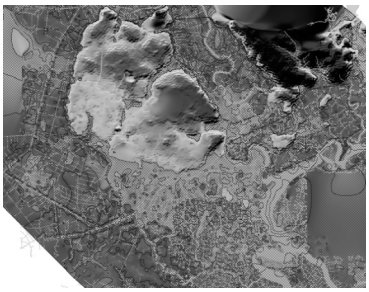


HCMC will become a polder system?

Remarks

- Climate changes may make current designs and planning outdated.
- Current flood management projects seem to be focus mainly on "Fighting with water".
- Local causes are currently dominant compared with that of global changes.

Inundation at water level +2.0

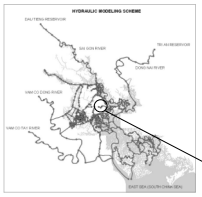


300 km^2 of HCM City would be flooded at water level +2.0

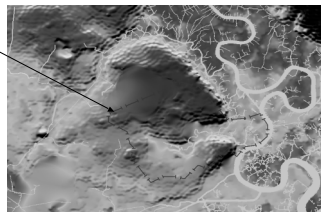
Impacts of Climate Changes on Urban Flooding

CASE STUDY
Nhieu Loc -Thi Nghe Project

Project outline



- Catchment area: 3500 ha.
- Cost: USD 200 Mil.
- Situation: Under construction phase



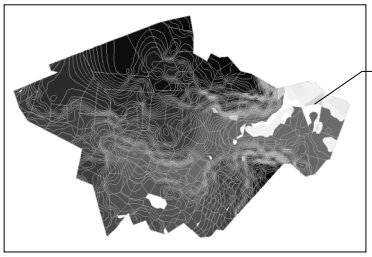
Study methodology

- Simulation with hydraulic model PCSWMM-NET
- Scenarios:
  - Current data
  - Projection: rainfall increasing rate of 0.8 mm per year
  - Projection: Sea level rise of 1 cm per year
- Evaluation: Flooded area

Hydraulic modeling

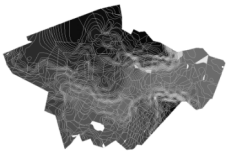
The sewer system of Nhieu Loc-Thi Nghe project has been simulated with designed parameters.

Impact of water level rise
Zmax = 154cm

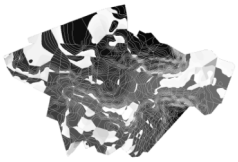


Without supplementary tide gate, some areas will remain flooded just after finishing the construction

Flooding prediction
under extreme rainfall events (with tide gate)



Rainfall volume (mm)	Flooded area (ha)
100	**40.1**



Rainfall volume (mm)	Flooded area (ha)
200	**926**

As heavy rainfall event keeps on increasing as resulted by Urban Heat Island effect, the project performance would be reduced remarkably.

Results and discussion

Results and discussion

Climate changes may result in non-stationary time series of rainfall and water level and require new analysis approaches.

Results and discussion

Climate change would reduce performance of urban drainage projects remarkably as conventional solutions may be inappropriate.

Results and discussion

Tide control measures alone could not solve the problems of rainfall increasing and land subsidence.

Results and discussion

The water level rise in Saigon river so far is mostly due to man-made impacts. The inundation is added by land subsidence.

An integrated approach is needed. It should be not only sustainable but also economical and environmental.

CONCLUSIONS

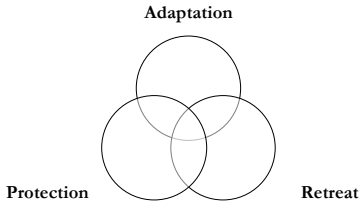
While sea level rise is still a potential danger, negative impacts of man-made activities has been present causes of the urban flood in HCMC.

Some additional measures should be carried out including: Detention of urban runoff, more room for rivers, ground water withdraw control, urban p…

"Fighting measures" such as polder and storm sewer upgrade are also needed, but may not be versatile.

Integrated, flexible and upgradable are requirements for the flood management strategy

CONCLUSION



Thank you for your attention

hlphi@hcmut.edu.vn

GHIÊN CỨU BIẾN ĐỔI KHÍ HẬU
– ĐẠI HỌC CẦN THƠ –
ON Institute – Mekong - CTU

International workshop on
"Role of Higher Education in adapting to climate and ecosystems change"
Ha Long, Vietnam, 23 – 24 August, 2009

CLIMATE CHANGE IMPACT ON RICE PRODUCTION IN THE MEKONG RIVER DELTA, VIETNAM

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(DRAGON Institute - Mekong – CTU)
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1. Background
2. Climate change in the Mekong Delta
3. Impacts of climate change on rice production
4. Discussion

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1. Background

Bản đồ vị trí các tỉnh
VÙNG ĐỒNG BẰNG
SÔNG CỬU LONG

The Mekong River Delta is a biggest agriculture and aquaculture production region of Vietnam (2,4 mil. ha of agricultural land/ 4 mil. ha total area)

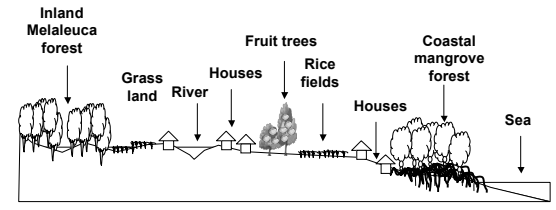
The Delta supplies more than 50% rice, 65% fish and 70% tropical fruit for the country.

1. Background

The endangered Sarus Cranes in Tram Chim

MD is considered as a larges wetland of the country which is very flat and low. This land has a high biodiversity and very sensitive in ecological characteristics.

1. Background




Melaleuca sp.

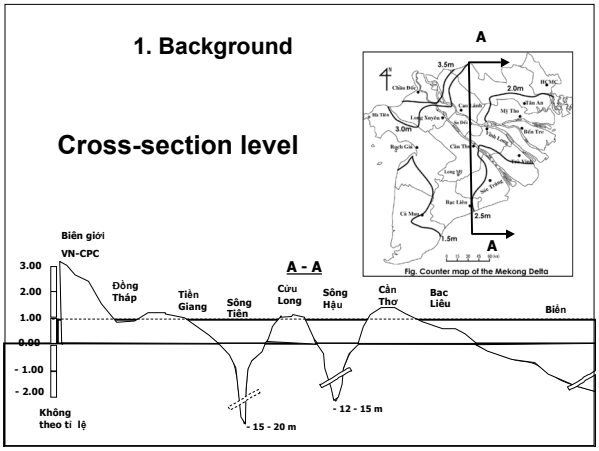

Rice and grass land


Rhizophora sp.

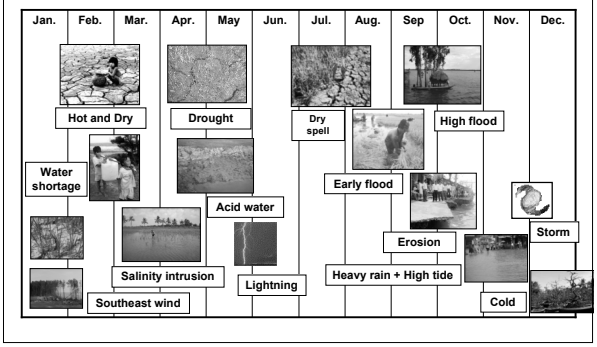

Coastal area

1. Background

Cross-section level



1. Background



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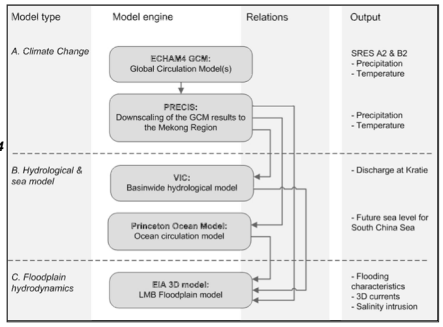
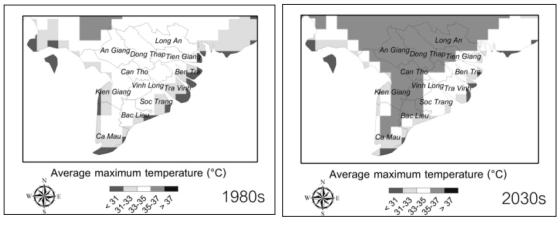
Southeast Asia START Regional Center

The future climate projection data was simulated by ECHAM4 Global Circulation Model under IPCC SRES. A2 GHG scenario and downscaled to high resolution using PRECIS regional climate model.



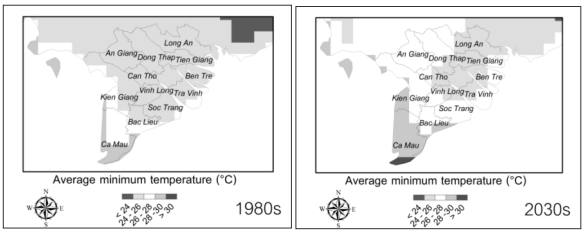
Results from regional climate model, regional hydrological simulation and ocean circulation model were then fed into hydrodynamic model, EIA 3D model, for more detailed hydrological analysis for the Mekong River floodplain system.

2. Climate change in the Mekong Delta



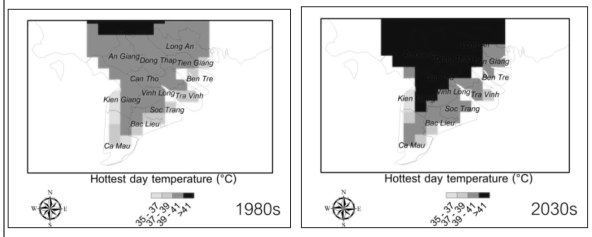
Average maximum temperature in 1980s and 2030s (simulated)

2. Climate change in the Mekong Delta



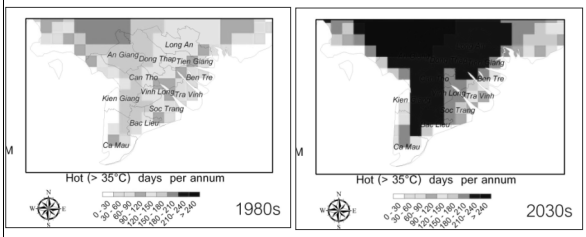
Average minimum temperature in 1980s and 2030s (simulated)

2. Climate change in the Mekong Delta



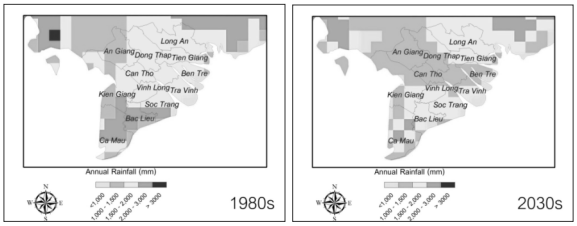
Average maximum temperature in the hottest day of the year in 1980s and 2030s (simulated)

2. Climate change in the Mekong Delta



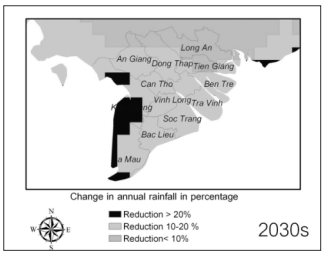
Number of hot days in a year in 1980s and 2030s (simulated)

2. Climate change in the Mekong Delta

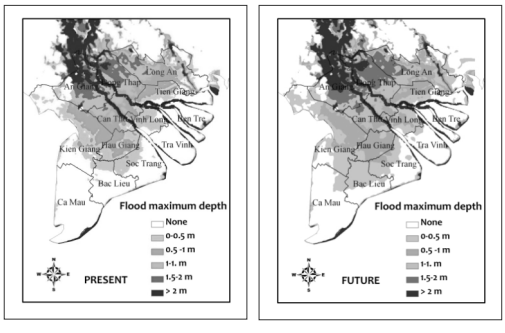


Annual precipitation in 1980s and 2030s (simulated)

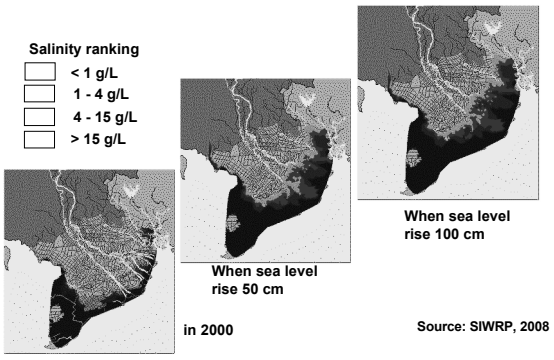
2. Climate change in the Mekong Delta



Change in annual precipitation compared between 1980s and 2030s (simulated)



Flood boundary in Mekong River delta in 1980s and 2030s (simulated)



Source: SIWRP, 2008

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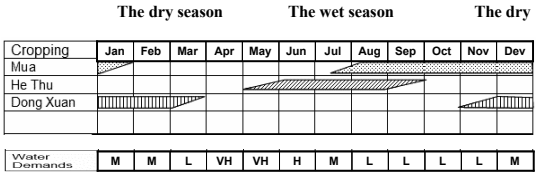
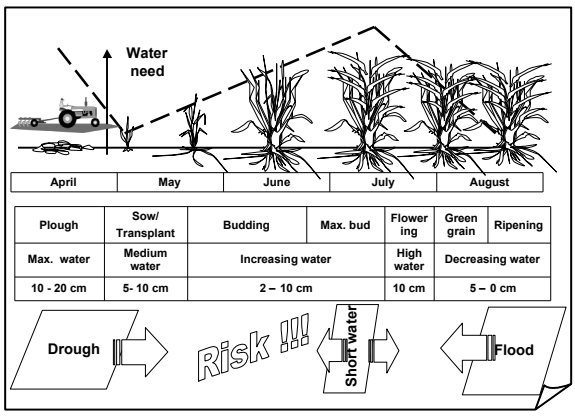
4. Discussion

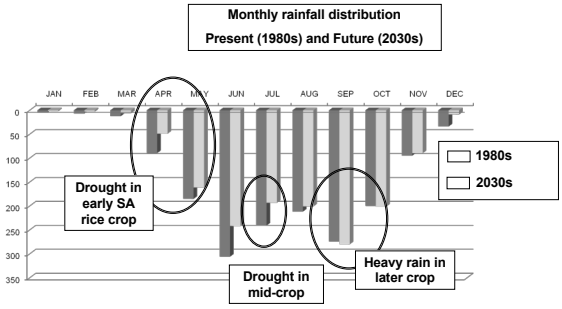
3. Impacts of climate change on rice production



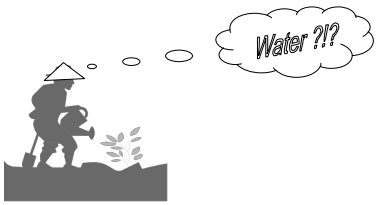
Cropping calendar and water demands in the MD
VH: very high; H: High; M: Medium; L: Low



3. Impacts of climate change on rice production

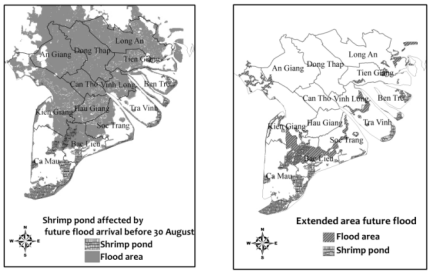


3. Key concerns on future climate threats

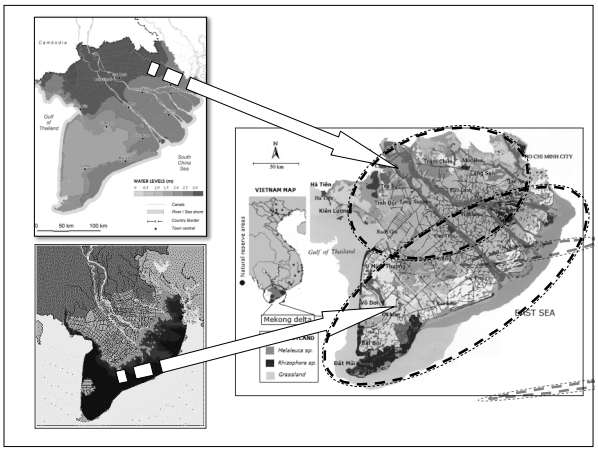


Higher risk in shortage of water at beginning of Summer – Autumn rice crop
In general, compared 1980s, the rainy season in 2030s:
+ starts late about 2 weeks (15/4 – 30/5)
+ total yearly rainfall amount reduces about 20%
+ in the future the farmers have to pay more for pumping water

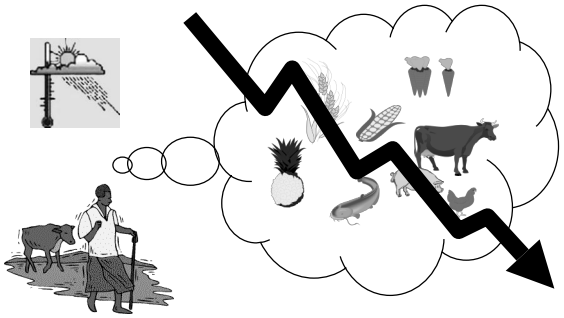
3. Impacts of climate change on rice production

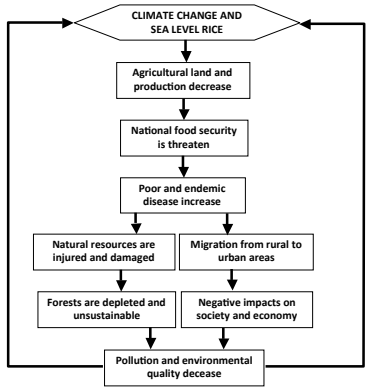


Extended flood area and affect some shrimp ponds.



3. Impacts of climate change on rice production





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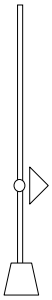


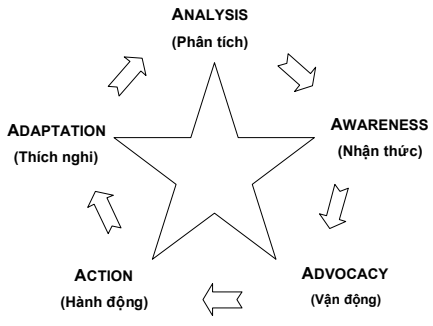
1. Background
2. Climate change in the Mekong Delta
3. Impacts of climate change on rice production
4. Discussion

4. Discussion

- This study is based on uncertainty of future change single – scenario.
- The MD region is considered to be the most seriously impacted area in the South East Asia in terms of rice and other food production, ecology and socio-economic.
- This is a critical issue that regional planners, policy makers, academic scientists, businessmen, local officers and people have to be aware of.
- It is suggested that an action plan for climate change mitigation and adaptation has to be drafted. The guidelines for climate change adaption are needed to written down..

5A approach

(Tuan, 2009)



Thank you for your attention

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ĐẠI HỌC QUỐC GIA HÀ NỘI
TRƯỜNG ĐẠI HỌC KINH TẾ

VALUATION OF ECONOMIC LOSS DUE TO CLIMATE CHANGE:

A NEW RESEARCH DOMAIN AND A NEW MAJOR IN THE COLLEGE OF ECONOMICS VIETNAM NATIONAL UNIVERSITY- HANOI

Bui Dai Dung, PhD
College of Economics, VNU-HN

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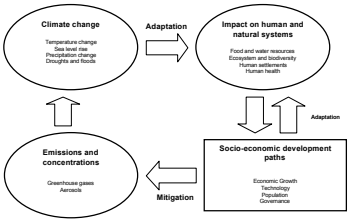
Contents

1. Climate change and its consequences
2. The role of universities in dealing with climate change
3. Economics Loss Valuation: a basic stage for solution seeking
4. COE-VNU HN actions.

ĐẠI HỌC QUỐC GIA HÀ NỘI
TRƯỜNG ĐẠI HỌC KINH TẾ

1. Climate change and its consequences

1.1. Consequences of climate change and socio-economic problems



Source: IPCC

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1. Climate change and its consequences

1.2. Impacts on Vietnam

- Vietnam- one of the most vulnerable country due to climate change and sea level rise
- Vietnam usually experience extreme events (Heavy rain, Flooding, Drought, Change of river flows, Soil erosion, Sea level rise and high tide)
  - ✓ Hurricane: 1954-present: 212 hurricanes, 4-6 hurricanes/year, 1964 (18 hurricanes), 1973 (12), 1978 (12), 1989 (10)
  - ✓ Typhoon: loss of 11,500 VND bill.; 400 died (2007); 1% GPD annually (during 2001-2006)

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1.2. Impacts on Vietnam

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1.2. Impacts on Vietnam

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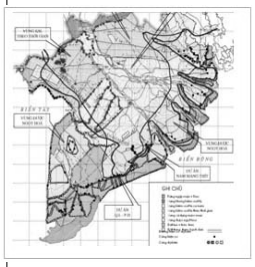
1.2. Impacts on Vietnam

Illustration of sea level rise in Mekong Delta in different scenarios



The Mekong Delta:

- ✓ Comprises 13 provinces,
- ✓ Surface: 39,712 km2, (12.1% of the country area).
- ✓ Population: 17.4 million (2006), 21% of the total.
- ✓ Agricultural output: 50%
- ✓ Exported food productions: 90%
- ✓ Fruit trees and aquaculture products: 70%
- ✓ Most of the natural area has a very low elevation (below +2.0m).
- ✓ Sea level rises up to 1m, an area of 15,000 to 20,000km2 in the Mekong Delta would be flooded (IPCC 2007)

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2. The role of universities in minimizing economic losses incurred by climate change

2.1. Warning the dangers and advising governments for appropriate solutions (international and national activities)

2.2. Raising public concerns and upgrading knowledge of population

- ✓ Upgrading knowledge of the population regarding climate change
- ✓ Actively participating to minimize negative impacts of potential disasters

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TRƯỜNG ĐẠI HỌC KINH TẾ

3. Economic Loss Valuation: a basic stage for solution seeking

3.1. The role of Economic Loss Valuation

- How much is the total loss of a specific extreme event?

  (How much the total loss should be in a supposed case, its impact on the economy in longterm)
- What are the main components of the total loss?
- What are the main causes that leading to the loss?
- What can we do to minimize the loss in similar events?

These are important information to find appropriate solutions

Interdisciplinary research, needs a tight and harmonious collaborations

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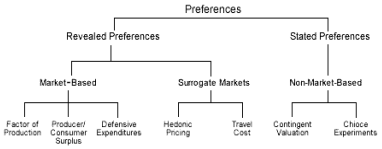
3. Economic Loss Valuation: a basic stage for solution seeking

3.2. Methods of Economic Loss Valuation

- TL = Environmental loss + Economic activities loss + expenditures
- Environmental loss = Environmental values (t) - Environmental values (t + 1)
- Total environmental value = direct-use value + indirect-use value + non-use value + intrinsic value
- Environmental Valuation Methods



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4. COE-VNU HN actions

4.1. VNU HN: A right place to launch interdisciplinary researches

- ✓ Having a large number of member colleges and faculties, covering relevant academic fields: geography, hydrography, meteorology, civil engineering, physics, biology, economics…
- ✓ Possessing a long tradition of fundamental science studies that attracted a large of number of leading experts and professors
- ✓ Working spirits and the tradition of close collaboration among the member units.

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4. COE-VNU HN actions

4.2. What we have done?

- A synthesis of theories and methods for valuating environment, habitat and economic loss due to climate change (May 2009)
- A research: "Valuation of Economic loss caused by the oil spill in Cu Lao Cham" (June 2008)
- Four researches (implementing 2009-2010)
  - ✓ Flooding in Cua Dat
  - ✓ Sea level rise in coastal area of Red River Delta
  - ✓ Soil depression in Hanoi
  - ✓ Land slides in Bac Kan Province

4. COE-VNU HN actions

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4.3. Action plan in the coming days

Two research programs:

- ✓ Set up a program of economic loss valuation for typical events in typical locations to look for coefficients between destroying power of the impacting agents and the sustainable capability of these areas.
- ✓ Set up a program of economic valuation for typical areas in order to identify priority order in accordance with regional validities. This can be done for district, provincial, or national level.

4. COE-VNU HN actions

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TRƯỜNG ĐẠI HỌC KINH TẾ

4.3. Action plan in the coming days

Necessary activities:

- ✓ Strengthening international operations in training, researching and surveying, exchanging scholars
- ✓ Enlarging joint researches with foreign and Vietnamese scientists
- ✓ Accelerating process to set up the major of "Economic Loss Valuation" in COE, VNU-HN
- ✓ Pushing up the tight relationship between students and people, between education and practice.

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Thank you!

Hue University
Institute of Resources, Environment and Biotechnology
******

Climate Change Impacts and the community-based climate change adaption project in Thua Thien Hue province

Assoc.Prof. Le Van Thang, MSc. Ho Thi Ngoc Hieu
The Institute of Resources, Environment and Biotechnology - Hue University (IREB)

Ha Long, August 23th, 2009

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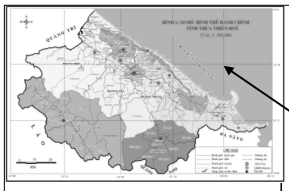
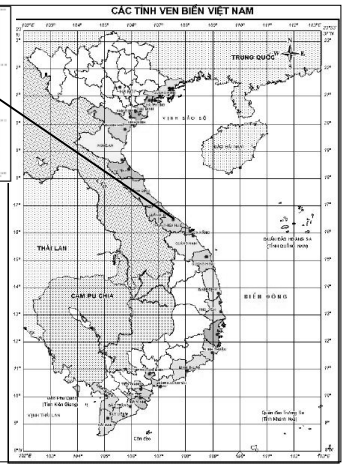
1. *General information*
2. *Some special weather phenomena*
3. *Main contents about a current research project of IREB*
4. *Conclusion*





Thua Thien Hue position:

- Co-ordinate: 16-16,80 North latitude and 107,8-108,20 East longitude

-Area: 5,054 km^2

- Population: about 1.2 million people (2009)
- 1 of 4 provinces of the key-point economic zone of the Central and one of the big cultural and tourism centers of the country.

Temperature characteristics

Lowest temperature (Tmin) vµ highest (Tmax) absolutely

Place	Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Hue	Tmin	8,8	10,0	12,5	14,1	17,7	20,9	19,8	21,0	19,2	15,9	12,9	11,1	8,8
	Tmax	34,6	36,3	38,6	40,0	41,3	40,7	39,8	39,7	39,7	36,1	34,9	32,2	41,3

Source: Meteorological and hydrographic characteristic in Thua Thien Hue

Rainfall characteristics

TT Hue province has the highest rainfall in Vietnam, with more than 5 meters of rain per year in the highlands and up to 3 meters of rain in the Hue city. Besides, the topography of the basin changes rapidly from upper stream down to plain, there is almost not a transition area. This results in a high runoff in the rainy season, big floods and inundation in wide areas.

Average rainfall per month, year (mm) in Thua Thien Hue

Place \ Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Co Bi	110	50	43	66	163	156	118	116	442	868	614	203	2959
Phu Oc	109	73	49	81	136	90	85	139	339	791	640	333	2865
Hue	114	56	38	56	112	190	73	124	375	754	665	321	2878

Source: Meteorological and hydrographic characteristic in Thua Thien Hue

Highest rainfall of day (mm) in Thua Thien Hue

Place \ Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Hue	166	78	109	89	153	255	353	206	405	582	978	336	978

Source: Meteorological and hydrographic characteristic in Thua Thien Hue,

Annually, there is about 150- 170 rainy days in coastal plan. In rainy season, each month has 16 – 24 rainy days.

Average relative humidity of atmosphere (%), vapour (mm), arid index

Địa điểm \ Tháng		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Năm
Huế	Độ ẩm	88	89	87	83	79	75	73	75	84	88	89	89	83
	Bốc hơi	43	39	58	79	114	133	150	132	80	56	47	40	971
	Chỉ số khô hạn	0,49	0,79	2,00	1,64	1,04	1,13	2,10	1,14	0,20	0,08	0,08	0,14	0,37

Source: Meteorological and hydrographic characteristic in Thua Thien Hue,

Average relative humidity per year of atmosphere increases following terrain height and has the value from 80 to 87% depending on the particular region. In coastal plan, relative humidity per year of atmosphere reach from 83 - 84%.

Prevalent wind direction, average speed, maximum speed (m/s) per year, month.

Địa điểm \ Tháng			I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Cả năm
Huế	Gió trung bình	Hướng	NW	NW	NW	NW, NE	NE, S	S,SW NE	S, SW	S,SW	Loạn hướng	NW, NE, E	NW ,NE,E	NW	NW,NE
		Tốc độ	1,8	1,9	1,9	1,7	1,7	1,8	1,7	1,6	1,6	1,8	1,9	1,7	1,8
	Gió mạnh	Hướng	NNW	N	NE	WSW	N	SW	WSW	WNW	NNW	W	N	N	NNW
		Tốc độ	16	14	20	30	20	17	23	19	38	28	21	19	38

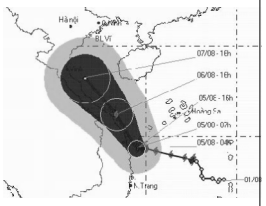
Source: Meteorological and hydrographic characteristic in Thua Thien Hue,

- In winter, prevalent wind direction in coastal plan is northwest (NW) with frequent of 25-29%, the following is northeast (NE) with frequent of 10 – 15%.

- In summer, prevalent wind directions in coastal plain are fairly complex and approximate, in which south wind direction (S) reaches 10 – 16%, southwest direction (SW) reach 11 – 14% and northeast (NE) is about 10 – 16%.

Some special weather phenomena

TYPHOON: According to data of 35 years (1952–2006) the annual average number of typhoons landing on Binh Tri Thien (Quang Binh, Quang Tri and TT Hue) is 0.63. Typhoon only appears from May to November, at most in September and October



Pabuk typhoon (No 2) (5/8/2007)

Number of typhoons landing on Binh Tri Thien during 1952 - 2006

Month	V	VI	VII	VIII	IX	X	XI	Total
Number of typhoon	3	4	3	4	10	8	3	35
Proportion (%)	9	11	9	11	29	22	9	100

Thua Thien Hue Province

TROPICAL CONVERGENCE: As tropical convergence occurs, on the sky there is an area of dense cloud of hundreds km wide, causing heavy rainfall on a large area.

HOT AND DRY WESTERLY: This is a special weather pattern representing the weather condition in the Middle of Vietnam. Hot and dry westerly appears from the last ten days of February and ends in the first ten days of September in depressed valleys and plain. The feature of hot and dry westerly is high temperature, low humidity, and wind of West direction.

At noon or afternoon, the highest air temperature can be over 35^0C, sometimes over 38 – 40^0C

Thua Thien Hue Province

FLOOD

According to data from 1977 to 2005, on the Huong River, on average every year there are 3.5 floods with the threat equal to or over the warning level 2, in which 36% are big floods or special big floods. Flood season is determined from Oct. to Dec. or later, in Jan, however in some years it is earlier, in Sept., or even May, June. Therefore, floods here include very early flood, early flood, main season flood and late flood.

Some problems about Climate Change Impacts in Thua Thien Hue (cont)

- We can see that both the flood and the drought risk of future CC impacts are very high for Thua Thien Hue.

Flood in Quang Thanh

Damage due to typhoon

Huong Phong and Quang Thanh Commune

	Huong Phong Commune	Quang Thanh Commune
District	Huong Tra	Quang Dien
Population	11.145 people, 2.245 households (2007)	11.352 people, 2.446 households (2007)
Village	6	9
Poverty rate	6 % (2008)	15 % (2008)
Income per capita	3,3 million/year (2007)	9 million/year (2007)
Labor	- Agricluture: 89% - Aquaculture: 9% - Other : 2%	- Agri- Aqua: 65% - Service – small industry: 27% - Other: 8%

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Huong Phong and Quang Thanh Commune

	Huong Phong	Quang Thanh
General problems	➢Injury and loss of life; ➢Illness after floods due to water-borne diseases, reduced food supply, lack of access to health care; ➢Loss of crops; ➢Loss of livestock, both in floods and due to disease, ➢ Destruction of transport, communication and electricity distribution infrastructure; ➢Damage to water control infrastructure (flood control and irrigation); ➢Damage to schools and health care facilities.	

PROJECT NAME

FLC 09-04

Project name: "***Community-based Adaptation to Climate Change and policy linkages in Thua Thien Hue Province"***

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GENERAL INFORMATION

EMBASSY OF FINLAND HANOI

Embassy of Finland

Institute of Resources, Environment and Biotechnology

- Duration: ***24 months*** (7/2009 - 6/2011)
- Project site : ***Huong Phong commune, Huong Tra district & Quang Thanh commune, Quang Dien district, Thua Thien Hue province***

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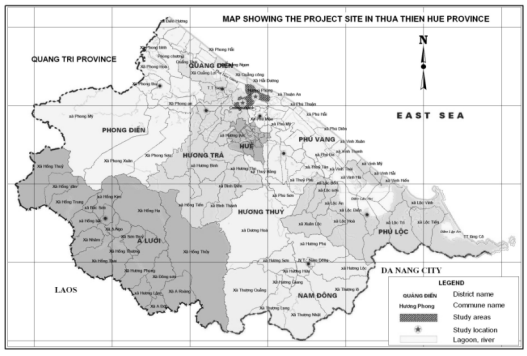

Location of the project

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Significance

- Provide scientific bases and local understanding on climate change awareness and adaptive capacity through case studies at one of the most vulnerable areas of Vietnam generally and Thua Thien Hue province particularly.
- Incorporate local problems and actions into developmental policy.

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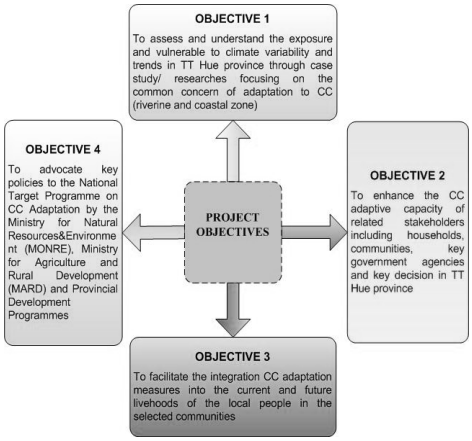
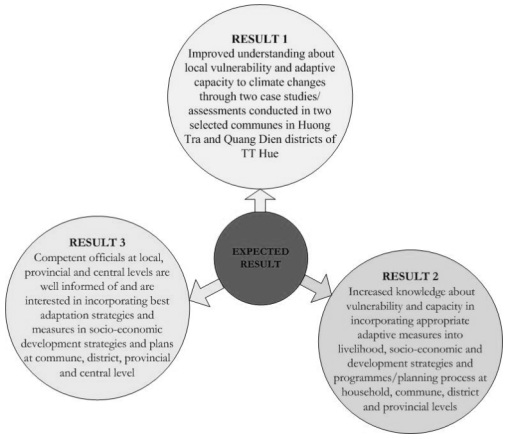




Project Components

The project will have three main components:

(1) Vulnerability and adaptative capacity assessments

(2) Awareness and training on adaptation

(3) Policy linkage and advocacy

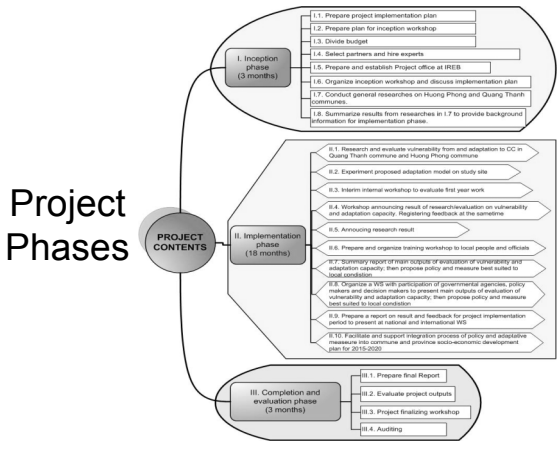
Each component has several planned interventions

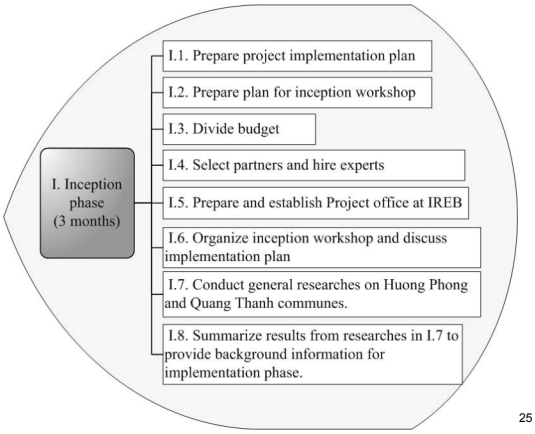
KEY BENEFICIARIES

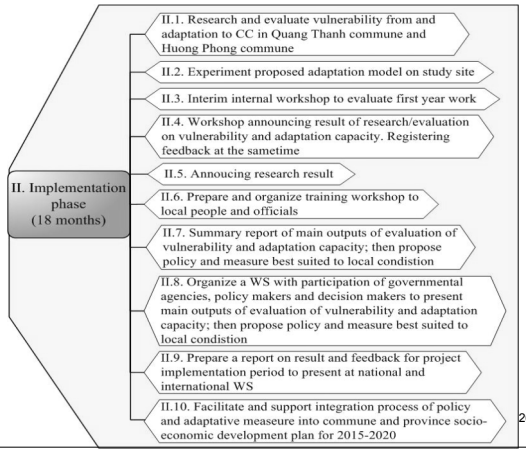
- The key beneficiaries of the project will be local people and local authorities at Quang Thanh and Huong Phong commune, Quang Dien and Huong Tra district, respectively of Thua Thien Hue province.
- The project will also reach beyond the target groups through disseminating the project training materials, documents/policy briefs summarizing lessons learned and feedbacks in order to replicate in other provinces and for policy advocacy purposes.

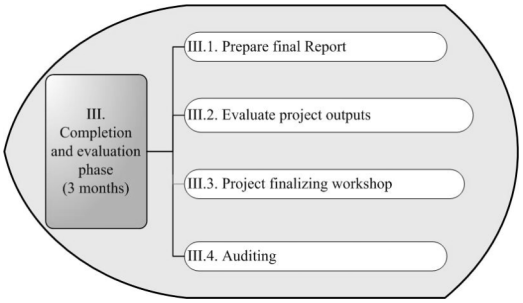
COLLABORATING AGENCIES

- Center for Environment Research, Education and Development (CERED);
- Provincial Department of Agriculture and Rural Development of Thua Thien Hue (DARD);
- Branch of Irrigation and Flood, Storm Prevention of Thua Thien Hue province;
- Provincial Department of Natural resources and Environment of Thua Thien Hue (DONRE);
- Huong Tra District People's Committee, Quang Dien District People's Committee, Huong Phong Commune People's Committee and Quang Thanh Commune People's Committee;
- And others to be identified as appropriate.









FLC 09-04 PROJECT PROGRESS

No.	Activities	Year 1				Year 2			
		Q1	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*
0	**Inception Phase**								
I	***Component 1***								
	Vulnerability and adaptive capacity assessments								
II	***Component 2***								
	Awareness and training on adaptation								
III	***Component 3***								
	Policy linkage and advocacy								
IV	***Project management and other activities***								
	Prepare periodic progress technical and financial reports								
	organize coordination meeting with collaborating agencies	♦	♦	□	♦	□	♦	□	♦
	Mid-term Internal Review and workshop								
	External Final Review								
	End-project workshop								♦
	Audit								♦

Conclusion

- The risks to Vietnam, including TT Hue province, are great, and the local authorities, communities and scientists must therefore join hands together to understand the province specific risks in order reduce them.
- This project does not only respond to the immediate needs of the province, which are the lack of public awareness and local capacity to address CC issues, but also target the most vulnerable women and men, and communities.

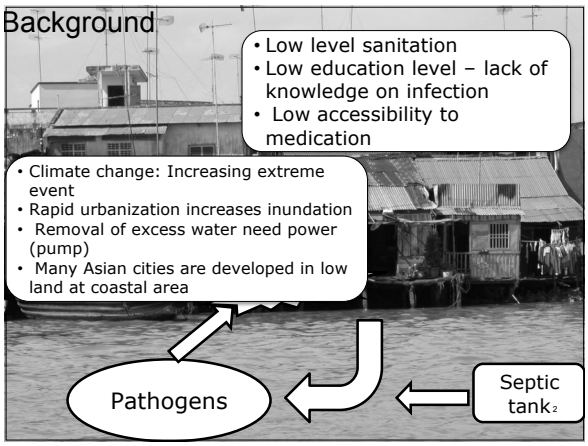
Thank you for your attention!

International workshop on
"Role of Higher Education in adapting to climate and ecosystems change"
Halong - Vietnam, 23 – 24 August 2009

Infectious Risk Assessment with Exposure to Pathogens in the Flood Water - Predicting the Effect of Climate Change

Kensuke FUKUSHI
TGIS, IR3S, the University of Tokyo, Japan
Tran Viet NGA
Hanoi University of Civil Engineering, Vietnam

Background



Background (Cont'd)

- Diarrhea outbreak after natural disasters in developing countries is more severe than that in developed countries (Bissell, 1983, Ivers *et al.*, 2006).
- Weather-related or flood-related naturals disasters as impacts of climate change tend to increase (Kunii *et al.*,2002,Ivers *et al.*, 2006, WHO, 2006).

⇒ Health risk assessment of infectious diseases related to flood is important.

Background (Cont'd)

- Infections risk assessment model introduced in IPCC AR4 is basically, WHO's malaria model.
  - Develop relationship between temperature and number of patients
  - No information of risk exposure pathway and amount to human
- Such model is inadequate to apply to design urban infrastructure to adopt climate change.

Research Objectives and Area

Research Objective

Characterize and quantify human health risks associated with exposures to pathogen in flood water

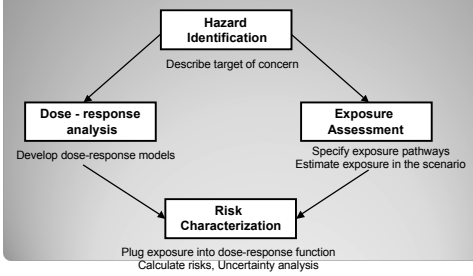
Research area selection

- Costal mega city in developing country
- Flood-prone area
- Low improvement of infrastructure

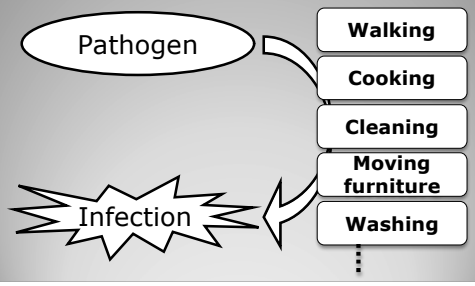
CITY OF MANILA
Area: 57km², population: 1,158,117 people (2000)

Methodology

Risk Assessment Framework (NAS, 1983)



Methodology



Methodology

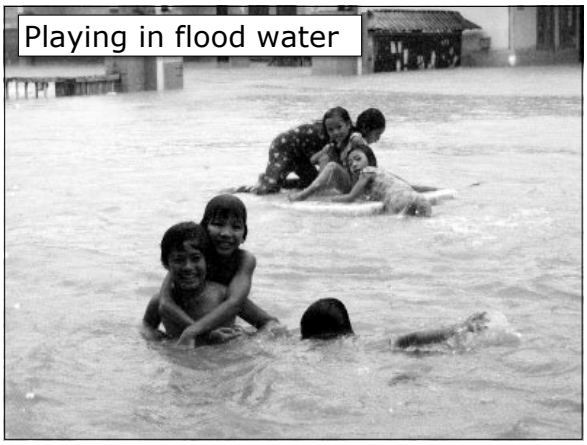
Exposure Scenarios

- Inundation depth of less than 50 cm
- Inundation depth of 50-100 cm
- Inundation depth of 100-200 cm
- Inundation depth of above 200cm

Table 1: Classification of inundation depth

Level	Inundation depth	Human behavior
I	0-50 cm	most houses will stay dry and it is still possible to walk through the water
II	50-100 cm	there will be at least 50 cm of water on the ground floor
III	100-200 cm	the ground floor of the houses will be flooded
IV	> 200 cm	both the first floor and often also the roof will be covered by water.

Note: Classification based on Flood Fighting Act, Japan, 2001



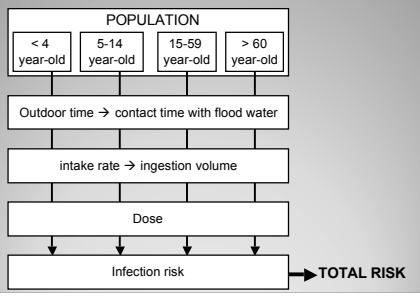
Methodology

Exposure Assessment

- E.coli concentration in flood water: indicator pathogen
- Exposure route: accidental ingestion through daily activities
- Human behavior survey: base on group of age
- Default ingestion intake: US-EPA Risk Assessment Guidance of Superfund (RAGS)

Methodology

Infectious Risk calculation method



Pathogen's dose-response model

Beta Poison model for *E.Coli* (Haas *et al.*, 1999)

Single infection risk

$$P(d) = 1 - \left[1 + \frac{d}{N_{50}}\left(2^{1/\alpha} - 1\right)\right]^{-\alpha}$$

d: dose
α = 0.1778
N50 = 8.6×10^7

⇩

Annual infection risk

$$P_{annual} = 1 - \left[1 - P(d)\right]^n$$

n: number of exposure times per year

City of Manila

Distribution of population and inundation water (from inundation data of year 2003)

• The serious flood areas where have high inundation level and high population density are District 1, 6, 12, and 14.

Estimated daily risk of infection via incidental ingestion of flood water in Manila City.

- Infected risk was calculated using the mean E.coli exposure level of 30,000 MPN/100 ml from the contaminated surface water data (Nga, 1998)
- Daily risks of gastrointestinal illness via incidental ingestion:

Risk	Inundation level
0.000674	0-50 cm
0.001345	50-100 cm
0.005631	100-200 cm
0.010328	above 200 cm

Estimated daily risk and number of infected people by districts, City of Manila

Estimation of infected people per day due to gastrointestinal illness via incidental ingestion of flood water in City of Manila

District	Population	Infected people (person) according to inundation depth of				Total (person)
		0-50cm	50-100cm	100-200cm	>200cm	
1	590,307	142	223	37	0	402
2	11,619	1	10	10	0	21
3	24,615	4	13	46	0	63
4	41,517	6	7	6	0	19
5	107,154	33	29	12	0	74
6	352,329	83	105	119	6	313
7	16,798	0	5	55	0	60
8	5,969	2	1	0	0	3
9	7,466	1	0	0	0	1
10	77,398	28	1	0	0	29
11	64,184	9	42	22	0	73
12	79,003	11	19	193	0	223
13	25,243	5	0	0	0	5
14	177,480	41	34	208	0	283

Single risk and annual risk associated with pathogen exposure during flooding period, for different group of age

Group of Age	Infection Risk ($\times 10^{-4}$)	Inundation depth (cm)			
		< 50	50-100	100-200	>200
0-4	daily risk	15	29	59	59
	total risk	294	577	1112	1112
5 to 14	daily risk	6	12	58	115
	total risk	119	236	1112	2071
15 to 59	daily risk	6	12	57	114
	total risk	119	236	1112	2071
>60	daily risk	1.5	3	15	15
	total risk	30	60	294	294
Total	daily risk	6.7	13	56	103
	total risk	**134**	**265**	**1068**	**1875**

Conclusions

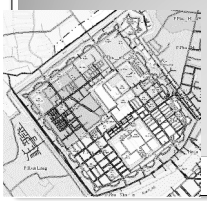
- In order to develop a quantitative assessment model, following information is necessary:
  - Precise flood level (10 cm, 20 min resolution)
    - Measurement and/or model
  - Pathogen concentration in flood water
  - Behavior of people
  - (Patients data for verification)

New research area

Hue, Viet Nam

No sewage works
Sewage pipes system
Drainage is discharged directly to rivers, ponds, soil .
Improvement of sewage pipes system is under construction
Lakes system
43 lakes built around 200 years ago for climatic consistency and flood drainage off , but now are not dredged regularly

⇒ Slow flood withdrawal, long inundation time



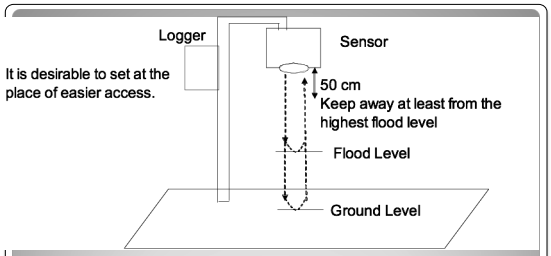
Sewage pipes system in Old Town

Solid waste disposed to the lake

Drain outlet

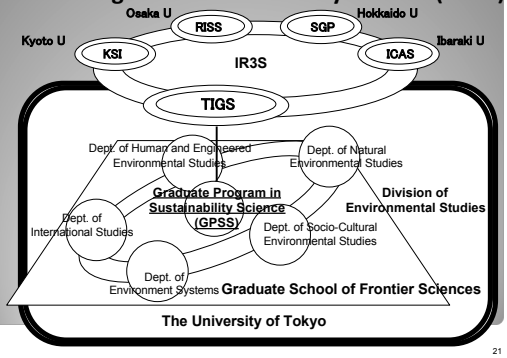
Area without sewage pipes system

Cultivation in lakes



Flood monitoring system

Graduate Program in Sustainability Science (GPSS)

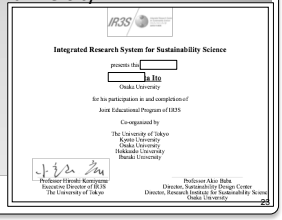


Characteristics of GPSS Education

- Diverse students
  - Nationality, cultural background
  - Academic background
  - All the lectures and course are carried in English
  - Scholarship programs (MEXT, ADB, etc.)
- A great variety of subjects related to sustainability in a holistic manner (supported by Division of Environmental Studies and IR3S-TIGS)
- Practical skills for understanding diverse, complicated and dynamic issues
- Skills for communication, facilitation and consensus building
- Attitudes to tackle sustainability issue
  - Accepting diversity and respect to minorities, detachment

IR3S Joint Educational Program

- "Frontier of Sustainability Science" (Common core course offered by five universities through a TV conference system)
- 2 courses which give students a holistic view of sustainability issues in each university
- Total 10 credits
- Presented to 11 student in April 2009



Integrated Research System for Sustainability Science

presents this

[redacted] Ito

Osaka University

for his participation in and completion of

Joint Educational Program of IR3S

Co-organized by

The University of Tokyo
Kyoto University
Osaka University
Hokkaido University
Ibaraki University

Professor Hiroshi Komiyama
Executive Director of IR3S
The University of Tokyo

Professor Akio Baba
Director, Sustainability Design Center
Director, Research Institute for Sustainability Science
Osaka University

Experience-based learning Programs

Intensive Program on Sustainability (IPoS) (2004 - Present)

- Looking to Sustainability in Asia, collaboration with Asian Institute of Technology
- Financial support by Nissan Science Foundation

Youth Encounter on Sustainability (YES)

(1999 - Present)

- Initiative by Swiss Federal Institute of Technology

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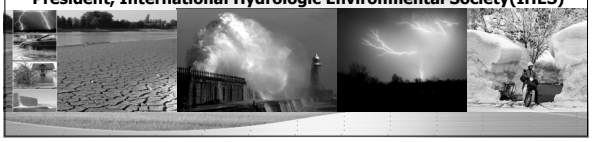
Climate & Ecosystems Change and Its Adaptation Programs in Korea

Prof. Dr. Soontak LEE

Distinguished Professor, Yeungnam University, Republic of Korea
President, International Hydrologic Environmental Society(IHES)



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CONTENTS

- Introduction
- Role of Human Beings on Climate & Ecosystems Change
- Climate & Ecosystems Change Vulnerability and Its Impacts
- Adaptation Measures and Programs
  - Adaptation Countermeasures
  - Research Activities in Various Sectors
  - Educational Programs
- Conclusion

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1 Introduction

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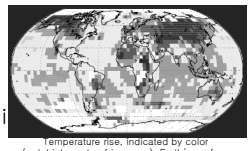
The Climate is Changing

- Temperatures are rising
- Sea levels are rising
- The ocean is acidifying
- Climate change is reflected i water cycle changes and in extreme weather



Temperature rise, indicated by color (red=higher rate of increase). Earth's surface temperature has risen ~1.3°F since 1850.

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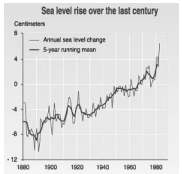
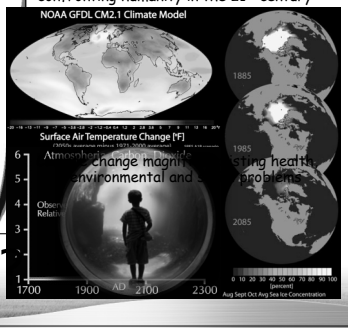
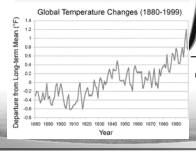
Climate Change Issue

Climate change is one of the biggest issues confronting humanity in the 21st century







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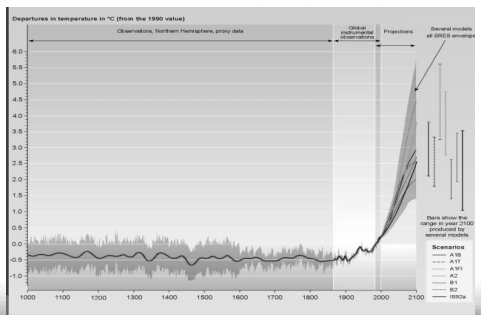
Variations of the Surface Temperature :1000-2100



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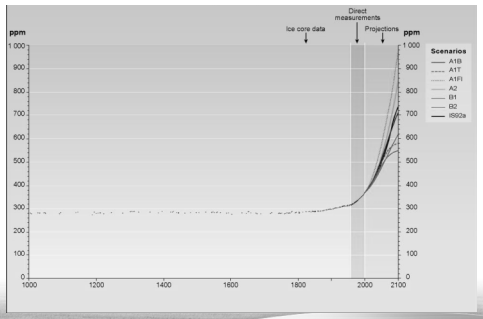
Past and Future atmospheric CO2



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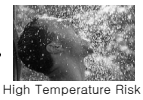
Impact of Climate Change on Disaster

Flood Risk



High Temperature Risk

Water resource & Quality Risk

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Ecological Impacts

- Living things are intimately connected to their physical surroundings.
- Ecosystems are affected by changes in:
  - temperature
  - rainfall/moisture
  - pH
  - salinity (saltiness)
  - activities & distribution of other species
  - …many other factors

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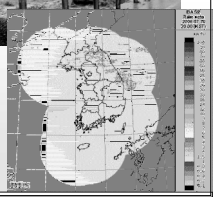
2

Role of Human Beings on Climate & Ecosystems Change



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The Role of Human Beings

- Causes of Climate Change

▪It is very likely that ***most*** of the climate change in the current era is the result of human activities.

- Human activities have increased concentrations of greenhouse gases in the atmosphere.
- These gases trap heat and cause the Earth to warm.

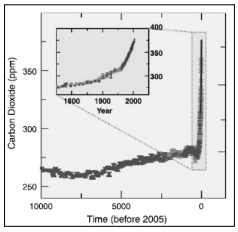

Figure adapted from Climate Change 2007: The Physical Science Basis. Working Group 1 Contribution to the 4th Assessment Report of the Intergovernmental Panel on Climate Change. Figure SPM.5. Cambridge University Press.

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The Role of Human Beings

- Rate of Climate Change

▪Climate change in the current era is expected to be extremely rapid compared to transitions in and out of past ice ages.

▪Ecosystems are more vulnerable to changes that happen rapidly.

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The Role of Human Beings

Compounding Factors

▪Human activities have many other effects on ecosystems.

▪These effects compound the effects of climate change, making it more difficult for ecosystems to adapt.

- Pollution
- Habitat fragmentation
- Invasive species
- Overfishing
- Manipulation of water sources
- … and much more

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The Role of Human Beings

Improving the Outlook

▪Changes in activities at the personal, community, and national levels can affect the rate of future climate change and species' abilities to adapt.

▪Some of the areas where changes in human activities could help species adapt include:

- Approaches to agriculture
- Water management practices
- Energy sources and use
- Transportation
- Pollution remediation
- Biological conservation
- …and much more

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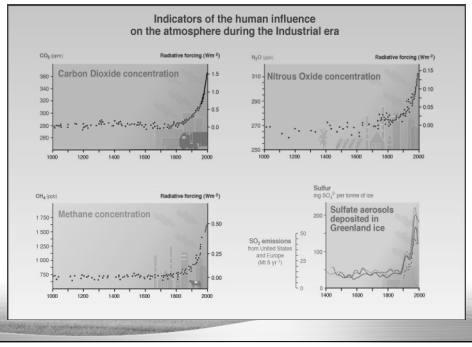
Indicators of the human influence



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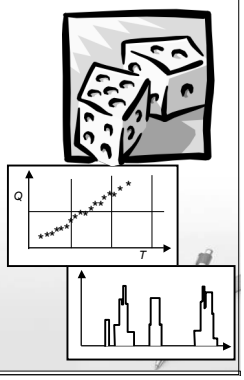
3

Climate & Ecosystem Change Vulnerability and Its Impacts



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Vulnerability to Climate Change and its Impact in Korea

◆ In the span of the last century average temperature has risen by 1.5℃ (global average has risen by 0.6℃)

-Temperature has risen from 12℃ in the 20th century to 13.5℃ in the 21st century even when excluding the effects of urbanization, there was an increase of 0.4 -0.8℃ (larger impact of urbanization rather than global warming)

◆ During the past 20 years, annual rainfall and days with heavy rainfall have increased in the Southern region of Korea- Increase of annual rainfall by 7% and days with heavy rainfall by 23%

-Decrease of annual number of rainy days by 14%
-Occurrence of extreme natural disasters such as the heaviest snowfall in 32years, the worst drought in history, and the heaviest rainfall in 37years, are rising in frequency and intensity

◆ It is estimated that the average climate will rise 1.2°by the 2020's, 2.4℃ by the 2050's, and 4.0℃ by the 2080's.

*** Long-term A2 Scenario based on the climate change model by the Meteorological Research Institute**

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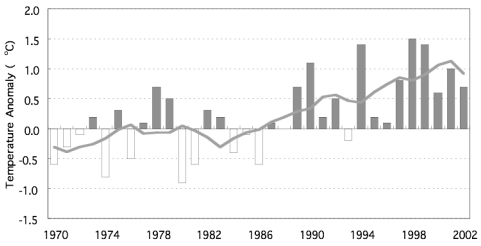
Temperature Variation (Korea, 1970-2002)



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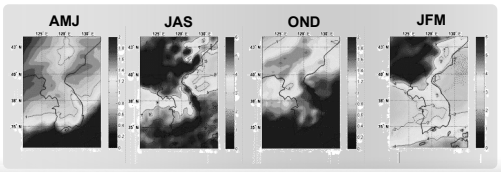
Projection of Abnormal Climate

RCM Scenario-KMARCM

- Difference (Present precipitation – 2015S, 2045S, 2075S precipitation)
  - Increased trend in summer season(significant trend is identified in the east coast)
  - Increased trend in winter season(significant trend is shown in the south coast



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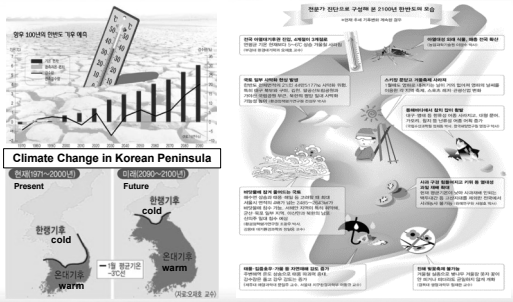
Climate Change Prediction at the Korean Peninsula in the 21st Century



Scientists predict that winter could disappear along the East and South seacoasts by 2100

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Vulnerabilities and Impacts on each Sector

Agriculture

- ◆ Regions ideal for cultivation will proceed northward and expand due to global warming
  - Cultivation areas for warm season fruits including tangerine, citron, and kiwi fruit will expand
  - Cultivation areas for temperate fruit trees such as apples, pears, peaches, grapes, etc are expected to face difficulties if global warming continues
  - ★ Parts of the region cultivating apples may have to abandon future cultivation
  - Possibility of cultivating subtropical fruit trees in Jeju Island is expected, but regions growing cool-season vegetables will have to move north
- ◆ Due to a rise in average temperature, frost damage has decreased yet the damage from noxious insects has increased
- ◆ A rise in frequency and intensity of damage due to agricultural atmosphere disaster
  - The frequency of typhoon, hurricane, heavy snow, drought, hail, yellow sand storms, etc has increased from 48 cases in 1910 to 190 cases in 1990

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Vulnerabilities and Impacts on each Sector

Forestry

- ◆ Change of air composition, such as the increase in density of CO2, and the extension of rearing period is anticipated to increase the productivity of mountains and forests
- ◆ On the contrary, limiting factors such as forest fires, landslides, outbreaks of insects, pests and plant pathogens may occur
  - the number of subtropical insects and pathogens, as well as forestry viruses such as the pitch canker are expected to increase due to the rise in winter temperatures, allowing their transfer.
- ◆ Trees more acclimatized to colder environments such as pine trees may decline in number due to rise in winter temperature

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Vulnerabilities and Impacts on each Sector

Fisheries

- ◆ There lies a possibility that the rise in water temperature will change the surrounding temperate waters of Korean Peninsula to subtropical waters
  - During the past 30-40years, the catch of warm water fishery species such as mackerel, anchovy, cuttlefish, etc has increased.
  - The winter fisheries for cuttlefish has moved 60miles north and expanded during the past 20years
- ◆ The catch of cold water fisheries species such as walleye pollack, codfish, etc had decreased sharply
- ◆ The rise in water temperature due to climate change may induce long-term and largescale red- tide, causing serious harm to the reproduction of fish and shellfish
- ◆ The rise in sea level will cause a serious loss of vast tidal flats
  - Since many fisheries resources such as micro algae, zooplankton etc inhabit in tidal flats, encompassing the vital ecosystem, the loss of the area will bring about serious future damage

※When the sea level rises by 1 meter, 1.2% of the total territory (2,643km²) and 2.6% of the total population (approximately 1,250,000 people) will be vulnerably exposed to the flood

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Vulnerabilities and Impacts on each Sector

Water Resources

- ◆ Increase in the threat of floods
  - Concentration of heavy rainfall in the summer will increase the damage due to floods
- ◆ Increase in the fluctuation of runoff will not add to the relief of water shortage
  - Droughts in Korea are severe due to massive fluctuations in runoff each season

Health

- ◆ Additional casualties due to intense heat will increase
  - In Korea, additional casualties due to intense heat were recorded in 1994
- ◆ In the northern regions of Gyeonggi province, there was a consistent reoccurrence of malaria since 1993

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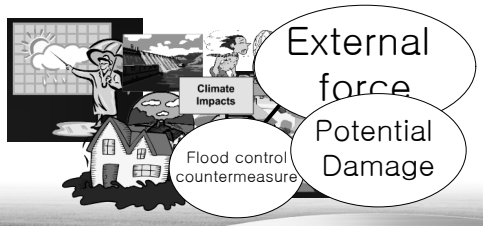
Change of Water Related Disaster Paradigm

- Change on Extreme Event: Frequent heavy rainfall & abnormal flood
- Increased property loss : amount of damage is increased while inundated area is decreased
- Problem on flood defense measure: Lack of comprehensive countermeasure for frequent flood event under climate change
  - Increased demand to improve design criteria under climate change
  - Need to have selected flood defense strategies to consider potential flood damage at regional scale



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Ecological Impacts

As a result of climate change, species and ecosystems are experiencing changes in:

- ranges
- timing of biological activity
- growth rates
- relative abundance of species
- Cycling of water and nutrients
- the risk of disturbance from fire, insects, and invasive species

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4

Adaptation Measures and Programs

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Adaptation Countermeasures

- Governmental Countermeasure Committee for the Agreement on Climate Change is launched (chairman: Prime Minister), in addition, a comprehensive plan was established and enforced four times in response to Climate Change
  - Till present, much emphasis was placed on the mitigation of Greenhouse Gas Emissions
  - The evaluation on the impact of climate change and its adaptation measures are at their initial stages
- Promotion for the basis of Adaptation on Climate Change, national target rate of the mitigation of GHG Emissions, warning system of Climate Change and disaster management system establishment were included from the 3rd('05~'07) and the 4th ('07~'12) Governmental Comprehensive Plan on Countermeasures to Climate Change

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Adaptation Countermeasures

- Agriculture
  - Foster species suitable to the changing climate
  - Change the farming methods and the kind of crops being cultivated
- Forestry
  - Forest hazard programs should be implemented to avert forest fires and landslides
  - Policies for the maintenance in the productivity of forests should be prepared
    - Planting of tree species adequate for colder climates should be avoided while substituting other adequate species
  - Alien pest insects and newly introduced plant pathogens (especially those from the subtropical regions) should be closely monitored through strict inspection
  - Implementation of the ecosystem preservation framework
    - The preservation measures in regard to the species vulnerable to climate change should be strengthened

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Adaptation Countermeasures

- Fisheries
  - The impact and response to the rise in sea level of the peninsular
    - Establishment of defense measures on coastal erosion and structures
  - Response to the diversification of fishery resources
    - continual monitoring of fishery resources through the prediction of the shift in fishery resources and change in fishing waters due to climate change
- Water Resources
  - Integrated countermeasures for floods among ministries and government agencies
  - Increased the efficiency of water resources management
  - A systematic and accurate structure that will predict early warnings of floods to the central government and local authorities in order to minimize the damage from disasters
- Health
  - The formation of a Fundamental management program and database for infectious diseases
    - Accumulate data from forecasts on the prevalence of malaria, Japanese encephalitis, cholera, vibrio, etc

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Research Activities in Various Sectors

Project for Climate Change Adaptation
– Water Resources –

- Establishment of Water Resources Assessment System for Major Basin Using Long-term Climate Forecasts
- Sustainable Water Resources Research Program (2001~2011)
- Research on Water Security Under Climate Change: This research is focusing on flood defenses, water resources, river environment and so on (2007~2010)


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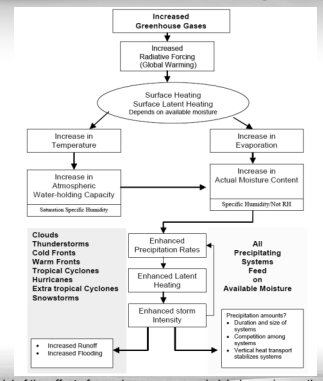

Conceptual model of the effect of greenhouse gases and global warming on the hydrologic cycle and

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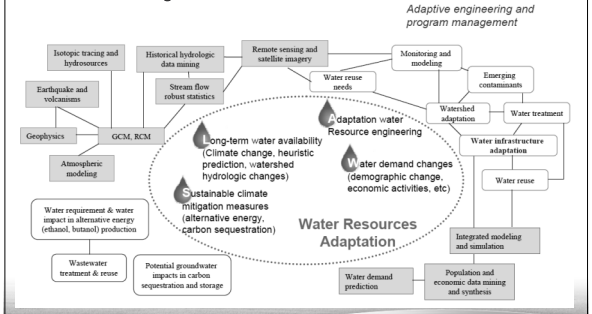
Sustainable Water Supply and Water Resource Adaptation to Global Change



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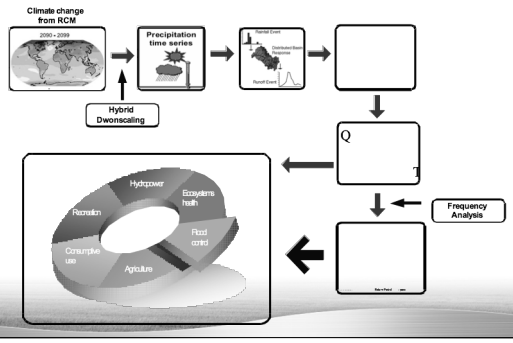
Design Considering Climate Change



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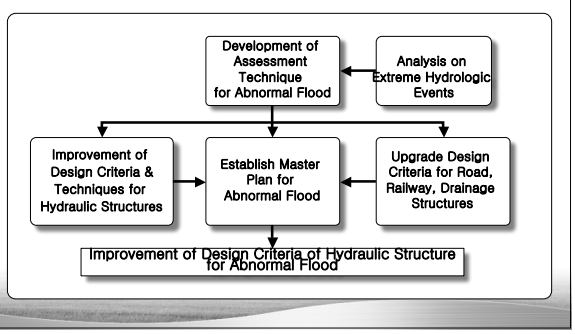
A research on "improvement of design criteria for abnormal flood"



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Project for Climate Change Adaptation
– Climate and Environment –

- Korea Climate Impacts Programme and Adaptation Action Programme
- Study of climate variability and climate change
  Development of climate prediction and climate change model
  Study of climate change impact and adaptation assessment
- Variation Analysis of Hydrologic Environment due to Global Warming in Korea
- Korea's Countermeasure System on CDM and International Base Strengthening of ET(Emission Trading)

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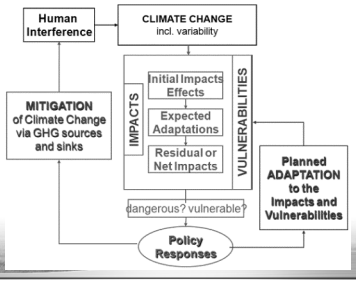
Educational Programs on Climate Change

◆ Some Universities and Research Institutes are offering Educational Programs on Climate Change in the field of Atmospheric & Environmental Sciences, Geoscience, Hydrology and Water Resources and Civil & Environmental Engineering according to the following Climate Change Processes



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Educational Programs on Climate Change

Apart from Regular University Degree Programs on climate change, the following special Educational Programs on climate change have been developed and are under operation at the present.

◆ **Special Graduate School Program on Climate Change**

- developed by Ministry of Environment(MOE) for the education and capacity building and strengthening of research base in climate change in 2006
- financially support university graduate students and the following research fields for five years initially;

- Greengas Emission Mitigation Measures and Policy
- Climate Change Impact Assessment and Adaptation Measures
- Impact Assessment and Monitoring
- Greengas Emission Statistics
- Business Management Strategies of Climate Industries
- Carbon Market and International Trading

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Educational Programs on Climate Change

◆ **KMAA Education Program on climate Change**

- Meteorological Science Academy of KMA operates special education and training course on climate change twice in a year for general people(NGO, business people etc.) and local government officials.
- Education subjects are all aspects of climate change and adaptation such as climate change impacts, adaptation measures, greengas emission mitigation & energy measures, national policies on green growth and carbon tax etc.

◆ **Local Government Education Center on Climate Change**

- Jeju Special Administrative Province established Climate Change Education Center in 2009

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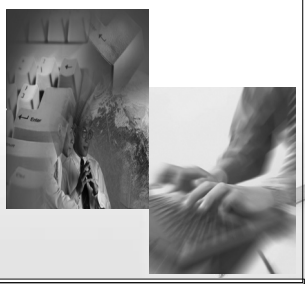
5 Conclusion



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Climate & Ecosystems Change and Impacts Occurrence

Great Vulnerability and Impacts to Climate and Ecosystem Change found and reflected in all global environment

Role of Human Beings causes most of the climate change

Change of Water Related Disaster Paradigm and Ecosystems are experiencing changes

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Adaptation Measures and Programs

Government comprehensive plan on countermeasures to Climate Change was established and Adaptation Measures are being implemented according to this plan

Various Research Projects and Activities on Climate & Ecosystems Change are being carried out

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Reinforcement of Disaster system

Disaster Prevention and Preparedness

Prevention

Infrastructure Maintenance & Improvement

Preparation

Disaster risk prediction & Monitoring system **improvement**

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Educational Programs on Climate Change

Development of New Higher Educational Programs on Climate Change

Special Graduate School Program and other several Education Programs on Climate Change are developed and executed

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Major three steps in addressing the current void in higher education and action for climate and ecosystems change are suggested ;

1) integrating climate change issues into basic and higher education curriculum
2) promoting innovative approaches of learning in formal and nonformal institutions
3) highlighting and enhancing diffusion of appropriate technologies for adaptation and mitigation of climate change

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Development of Higher Educational Programs on Climate Change

Current Educational and Research Programs

Change to New Paradigm and Educational & Research Programs on Climate Change

New Curriculum Development on Climate Change Adaptation

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Best Practice and Challenges of Integrating Education, Research, and Community Empowerment for Strengthening Higher Education's Role in Climate Change Adaptation

The Case Study of Indonesia

Dr. Tumiran
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The Indonesia National Energy Council Member

tumiran@te.ugm.ac.id

(*) presented at UNU-ISP and IR3S Conference on Role of higher education in adapting to climate change
Hanoi, August 23-24, 2009

Outline

- **Introduction**
- **The Setting of Indonesia**
  - **Developing country with very large population**
  - **Economic growth and energy crisis**
  - **Climate change adaptation : regulation and action**
- **Integrating Education, Research and Community Empowerment**
- **UGM outreach program for community empowerment**
  - **Community empowerment**
  - **Student empowerment : future generation**
- **Climate Change Adaptation at UGM**
  - **Education**
  - **Research**
  - **Community empowerment**
- **Best practises**
  - **Student community services (undergraduate program)**
  - **Education (master program)**
  - **Applied research**
  - **Networking**
- **Existing Gaps**
- **Concluding Remarks and possible cooperation**

Introduction (1)

- It is well understood that impacts of climate change felt today was triggered mainly by human activities since many year ago.
- The increase in temperature of the earth near-surface air and oceans has caused various impacts on the human life and the earth environment.
- The increase of sea level, the change of seasons, the El Nino effect and the loss of several islands were believed as the impact of the climate.
- Unless fast and integrated action through mutual understanding and international cooperation is taken seriously, the climate change will lead to a disaster in human life.

Introduction (2)

- Started since the industrial revolution, human activities have increased the amount of GHG in the atmosphere such as CO2, CO, CFCs and nitrous oxide.
- The extensive exploitation and utilization of fossil fuel and land-use-change through deforestation are among human activities leading to GHS in the atmosphere.
- On the other side, public the awareness on the climate change issue has not been developed yet. There is still discrepancy among the way of thinking, the policy and the implementation strategy between different nations.
- In the meantime, the role of higher education in adapting climate change has not been yet fully developed as integrated, interdisciplinary and continuous action.

INDONESIA

Geographic Spread

The Setting of Indonesia

- **Indonesia is the world's fourth most populous nation with 240 million people.**
- **It is spread over a large archipelago tropical regions of more than 6000 inhabited islands, but 80% population live in Java-Madura-Bali.**
- **Indonesia is engaged in radical transition (reformation) from an autocratic, centrally planned economy to a democratic community.**
- **The benefit of the reformation is already visible :**
  - **Indonesia is clearly more open, confident society and more respect to human right than it was before.**
  - **Indonesia has quite stable political situation with good balance between governments and parliaments**
  - **Economic growth has returned to a stable 5-6% annually after the Asian financial crisis in 1997-1999**

The Setting of Indonesia

- Indonesia still has a number of challenges
  - Unemployment rate is persistently high.
  - There is severe poverty in rural areas and on the urban margins
  - Basic services such electricity and water are limited.
- The challenges in the energy sector are many, such as
  - declining in oil and gas production,
  - fast in increasing domestic requirement of oil and gas,
  - population is spread over a large number of islands.

The Setting of Indonesia

- As a large archipelago tropical country Indonesia will be badly affected unless appropriate actions (local, national, regional and international) are carried out to address climate change.
- Indonesia's programs in adapting to climate change
  - Commitment and Regulation such as : Indonesia's commitment to cut energy sector emission by 17% by 2025 and implement bold reductions in forest burning. This commitment was announced in May 2008 and applauded by the International experts. In addition to that, newest regulation in waste management basically ban open dump waste.
  - Transportation sector : 'blue sky' program ; increasing and improving public transports in big cities.
  - Industries : emission reduction, chemicals replacement, eco-friendly products, co-firing in CPO plants.
  - Increasing the utilisation of non-fossil energy sources mainly geothermal (the biggest reserve in the world, equivalent to 27,000 MW), biofuel and hydro-wind-solar.

GOI Policy Related to the Climate Change

- Indonesia signed the UN Framework convention on climate change (UNFCCC) on 5 June 1992
- On August 1st 1994, The President of RI approved the Act of Ratification of UNFCCC No.6/1994
- On August 23 1994, the document was submitted to the Secretary General of UN

Green House Gas Emission

- Indonesia made its first National Submission to the UNFCCC in 1999 and this submission includes an inventory of the most significant green house gases (GHGS) for 1994. GHGS included in the inventory are CO_2, CH_4, N_2O, No_x, and CO.

Clean Development Mechanism

- In order to meet the requirement of the Clean Development Mechanism (CDM) in line with the Kyoto Protocol, the Ministry of Environment has establised a committee on the Clean Development Mechanism through the Ministrial Decree No.206/2005.
- The committee includes representatives from the concerned ministry including Energy, Forestry, Industry, Transportation, and BAPPENAS.
- The committee has responsibility to grant CDM project proposals :
  - Track and documents in the CDM Executive Board
  - Monitor and evaluate the performance of the CDM project
  - Submit an annual report to the UNFCCC.

GOI Project Related to the Climate Change

- In 2007 – 2008, Presidential decree to obligate household used to convert the gasoline to LPG. LPG tank is prepared by GOI and subsidized.
- In 2007 – 2008, National State Electricity Company (PLN) : Distributed to its customer 10.000.000 tube lamps (saving lamp) to subtitute fillament lamps free of charge. The effect is drastically reduced the electricity generation power plant.

Policy in Energy Sector

Natural Energy Production and Reserve (2007)

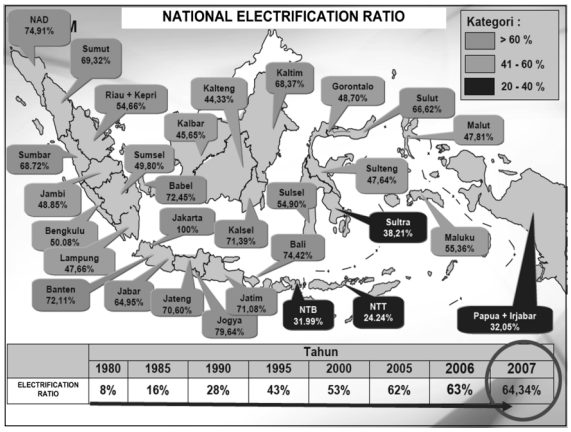
Fossil Energy	Potential Resources	Reserves	Production	Res./Prod. (years)
Oil	56,5 billion barrel	8,4 billion barrel*)	348 million barrel	24
Natural Gas	334,5 TSCF	165 TSCF	2,79 TSCF	59
Coal	90,5 billion ton	18,7 billion ton	201 million ton	93
Coal Bed Methane (CBM)	453 TSCF	-	-	-

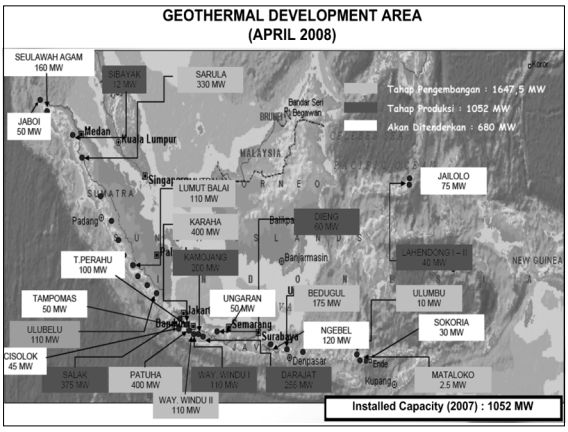
*) Including Cepu

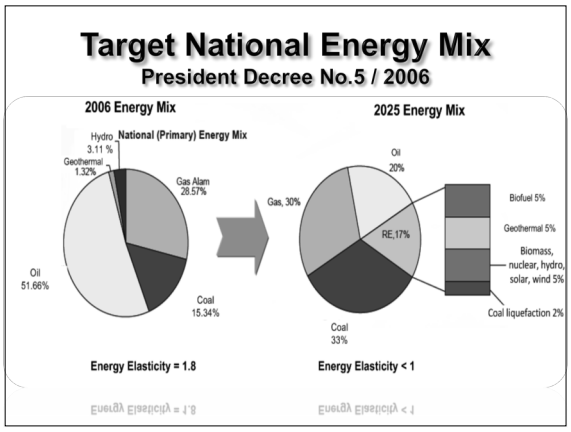
Natural Energy Production and Reserve (2007)

Renewable Energy	Resources	Installed Capacity
Hydro	75.670 MW (e.q. 845 million SBM)	4.200 MW
Geothermal	27.000 MW (e.q. 219 million SBM)	1.052 MW
Microhydro	450 MW	84 MW
Biomass	49.810 MW	300 MW
Solar	4,80 kWh/m²/day	8 MW
Wind	9.290 MW	0,5 MW
Uranium	3.000 MW (e.q. 24,112 ton) for 11 years*)	30 MW

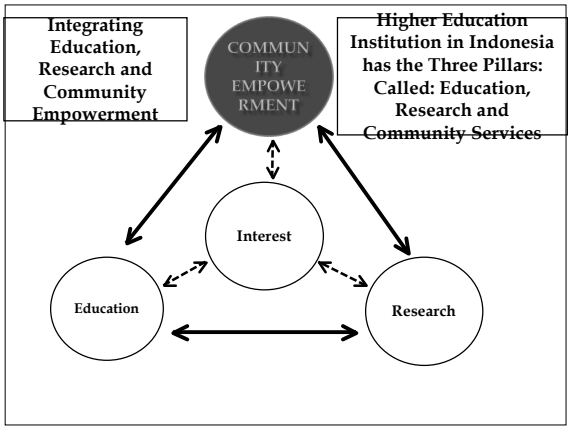
*) Only from Kalan - Kalimantan



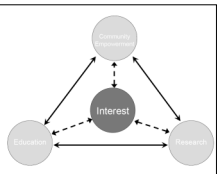




Education, Research and Empowerment based UGM Experience



Integrating Education, Research and Community Empowerment



- Higher education institutions in Indonesia has the Three Pillars: Education, Research and Community Services.
- All academic staff and students have obligation to do all of the three pillar.
- Key words in community services
  - based on education and research,
  - promote public / community action / participation
  - networking of relating stakeholder

Integrating Education, Research and Community Empowerment : the Case of Universitas Gadjah Mada (UGM), Indonesia

- University of Gadjah Mada (UGM) is a largest and oldest state-owned university in Indonesia which is very active in education, research and implementing community outreach programs.
- UGM has 18 faculties with more 2300 faculty members, 55000 students (including 12000 at faculty of engineering) coming from all over Indonesia area and more than 600 foreign students.
- In 2008, UGM ranked 316 in the world on THE-QS ranking and 57 in Asia on Webometrics.
- UGM is one of three universities in Indonesia that received World Class University award from the President of Republic of Indonesia.
- United Nation has also appointed UGM as the host of the Regional Centre of Expertise (RCE) Yogyakarta in the Education for Sustainable Development (EfSD).

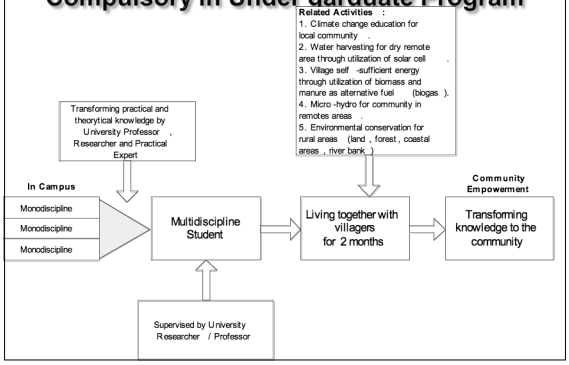
UGM outreach program for community empowerment

- **UGM is well connected with local government networks, and also currently appointed by the Directorate General of Higher Education of Indonesia as the national focal point for managing university network for student community service (SCS) outreach programs.**
- **Example of successful outreach programs :**
  - **UGM play very important role in the successful post-2006 earthquake rehabilitation and reconstruction programs for Yogyakarta and Central Java Region.**
  - **Student Community Service – Community Empowerment Learning (SCS-CEL). The SCS program was initiated in 1951. It has been a compulsory subject for undergraduate since 1971.**
  - **University-Industry-Community (UIC) through Hi-Link Project (supported by JICA and DGHE)**

Student Community Service Program

- **Student Community Service – Community Empowerment Learning (SCS-CEL).**
  - **The main objective of SCS-CEL program is to increase empathy and solidarity of students toward the poor and the weak. This is considerably important since students are the future backbone of the nation.**
  - **It is a compulsory subject for undergraduate program's students.**
  - **Students (supervised by faculty members) must stay and work together with community, usually in rural areas, for at least two months.**
  - **This program is always upgraded following the issues which are developed within communities and faculty member research's findings.**
  - **Multidiscipline approach**
- **The SCS-CEL emphasize community empowerment. It is bottom-up ; based on theme and research-based program.**

Student Community Service Program Compulsory in Undergarduate Program



Example of Climate Change Adaptation in Faculty of Engineering of UGM :

Academic

- **Climate change adaptation has been done through incorporating various courses related to sustainability development and climate change into both undergraduate and graduate programs :**
  - **Implementation of education for sustainable developments (EfSD)**
  - **Emphasis on environmental issue such as Department of Civil and Environmental Engineering (previously Department of Civil Engineering)**
  - **Student's final projects related environmental issues.**
- **Establishing new post graduate programs (within Faculty of Engineering UGM) related to climate change such as :**
  - **micro hydro power system (since 2002)**
  - **pollution prevention (since 2003)**
  - **water resource management (2000)**
  - **municipal solid waste treatment and management (2004, in cooperation with local government)**

Climate Change Adaptation in Faculty of Engineering of UGM :

Rresearch

- Renewable energy from biomass waste and biofuel (supported by national and local governments, in cooperation with international agencies)
- Hydropower, energy conversion and conservation
- Land reclamation and conservation (well recognized in national level)
- Eco-product development and eco-efficiency process
- Sustainable infrastructure development and public transportation
- Sustainable water resource management (supported by Minister of Public Work and in collaboration in with international agencies)
- Urban planning and spatial arrangement
- Sustainable resources management in mining site

Climate Change Adaptation Faculty of Engineering of UGM :

Ccommunity empowerment

- Student Community Service – Community Empowerment Learning (SCS-CEL). Some example of SCS-CEL program addressing climate change issue, such as
  - Incorporating global climate change education for local community.
  - Water harvesting for dry remote area through utilization of solar cell.
  - Community empowerment related to rainfall harvesting for fulfilling community basic needs.
  - Village self-sufficient energy through utilization of biomass and manure as alternative fuel (biogas).
  - Micro-hydro for community in remotes areas.
  - Environmental conservation for rural areas (land, forest, coastal areas, river bank)
- Applied research
  - Waste refinery converting municipal solid waste into valuable products such as energy and bio-fertilizer.
  - Micro climate reclamation in coastal areas.
  - Eco-hydraulic, eco-product and eco-efficiency.

Example of Climate Change Adaptation in UGM :

Academic

- Related academic activities in other faculties in UGM, such as
  - Faculty of Geography : bachelor, master and PhD program in environmental science
  - Interdisciplinary master program in infrastructure management and community development
    - Involving at least 4 faculties : Faculty of Engineering; Faculty of Social science; Faculty of Economic and Business; Faculty of Geography
    - In cooperation with ITC, Netherlands
  - Faculty of Agriculture : master program in Integrated Farming

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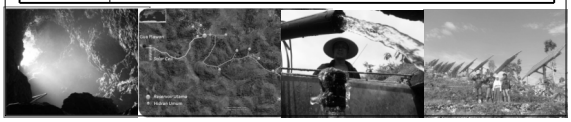
Best practices of climate change adaptation : community empowerment

Water harvesting for dry remote area through utilization of renewable energy

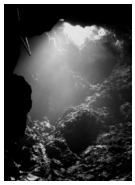
Year	2006-2008
Location	Giricahyo, Sub distric Purwosari, Gunungkidul, Yogyakarta
Institutions	Faculty of Engineering UGM; The Institute for Research and Community Service; Team Waterplant Community UGM; Ministry of National Education; Local Government of Gunung Kudul; Ministry of Public Work; National Bank Association, other institutions
Student involvement	About 200 hundreds students (five period of community service programs, 2006-2008)
Output	Water availability in the dry remote area in Giricahyo village
Sustainability	Self management of water pumping system



Latar Belakang

- Desa Giricahyo, Purwosari, Gunungkidul, mengalami kekeringan pada musim kemarau
- Aspirasi masyarakat untuk menanggulangi kekeringan
- Terdapat sungai bawah tanah yang mengalir sepanjang tahun di Gua Plawan.

- Pada tahun 2005, sumber air Gua Plawan mulai di investigasi oleh mahasiswa UGM.
- Sungai bawah tanah di Gua Plawan berada pada kedalaman 107 m di bawah permukaan tanah



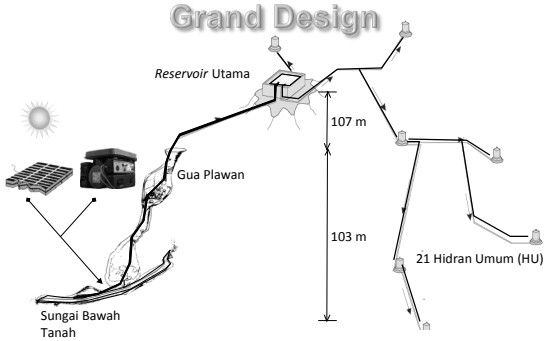
Inisiasi KKN PPM-UGM
Tahun 2006 – 2008 (dalam 5 tahap)

- KKN PPM sebagai sarana untuk menyelesaikan permasalahan di masyarakat bersama masyarakat.
- KKN PPM memiliki pendekatan sosial dan teknis.
- KKN PPM sebagai *treatment* dalam pemberdayaan masyarakat.

Studi Kelayakan

- Survey Teknis: perencanaan instalasi pengangkatan air, uji kualitas air, dan metode pendistribusian
- Survey Sosial: kebutuhan air, monografi desa, tingkat perekonomian, institusi lokal
- Pendanaan awal studi didukung oleh Ditjen Dikti DEPDIKNAS melalui Program Kreatifitas Mahasiswa (PKM)

Grand Design



KKN PPM Eksploitasi Air Gua Plawan Dengan Energi Terbarukan Tahap I

- Pemetaan jalur pipa transmisi dan distribusi, Pembuatan tangga dan elektrikal dalam gua

KKN PPM Eksploitasi Air Gua Plawan Dengan Energi Terbarukan **Tahap II**

- Instalasi pompa *submersible*

- Pemasangan *generator set* 45 kVA sebagai daya pompa.

Pompa Air Tenaga Surya (PATS)

Merupakan sistem sekunder yang berbeda dengan sistem *generator set* eksisting.

Penyebaran Titik Hidran Umum

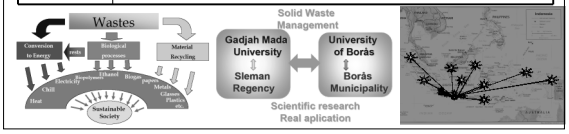
Program Waterplant Community

World Water Day and Expo di Jakarta

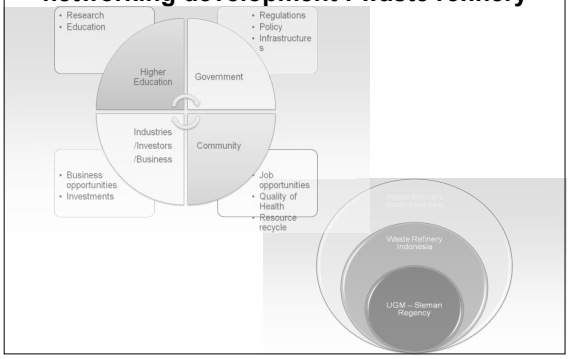
Inisiasi 4 KKN PPM UGM di 3 Kabupaten di DIY

Best practices of climate change adaptation : networking development : waste refinery

Year	2006-now
Location	Sleman, Palu, Pontianak , Jayapura, Kulon Progo, and other cities. This program will be expanded to neighbouring countries including Thailand (in cooperation with AIT).
Partner	Local governments, Ministry of Environment, Ministry of Home Affairs, Ministry of National Education, Ministry of Foreign Affair, supported by Swedish government through NUTEK and SIDA.
Activities / Result	The establishment of network on waste refinery in Indonesia; Building demonstration plant converting waste into energy and fertilizer; Waste sorting at university; Improvement of social awareness and technical ability on waste management and conversion of waste to valuable products;
Student involvement	3 PhD students, 25 master students, a lot of undergraduate program



Best practices of climate change adaptation : networking development : waste refinery



Best practices of climate change adaptation : community empowerment

Micro-climate reclamation in coastal areas

Year	2005 - now
Location	Pandansimo area, Srandakan sub-district, Bantul district, Yogyakarta
Results	Micro climate reclamation for agriculture purposes
Partner	PT Indmira
Student involvement	Undergraduate students

Best practices of climate change adaptation : networking development

CKNET-INA: Infrastructure, Water and Environmental management

Year	2002 - now
Member	10 big universities in Indonesia including UGM (Dean of Faculty of Engineering UGM is one of the steering committee)
Vision	To become a sustainable academic and professional network to build capacity in the sectors of infrastructure, water and environment
Program	Water Resources & Irrigation Management Capacity Building Network Training demand assessment Capacity building need assessment
Affiliation	UNESCO-IHE, CapNet and AquaJaring

UNESCO-IHE Institute for Water Education · Cap-Net · AquaJaring

Gadjah Mada University (UGM) is a member of Environment Management related Network:

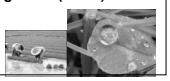
CKNET-INA

COLLABORATIVE KNOWLEDGE NETWORK INDONESIA
INFRASTRUCTURE, WATER AND ENVIRONMENTAL MANAGEMENT

Network's Name, Logo and Membership

THIS NETWORK ORGANIZATION IS CALLED COLLABORATIVE KNOWLEDGE NETWORK INDONESIA, ABBREVIATED INTO CKNET-INA.

CKNet-INA (Collaborative Knowledge Network Indonesia) is a collaborative knowledge network consisting of *people* working in public and private knowledge centers (universities, research institutes, etc.) in Indonesia concerned with the human resources capacity building and knowledge development in the fields of Infrastructure, Water and Environmental Management (IWEM).



VISION

To become a sustainable academic and professional network to build capacity in the sectors of infrastructure, water and environment where the members can share and exchange knowledge, so that development and distribution of knowledge can be improved to support decentralization and development programs in Indonesia.

Deliver Capacity Building in IWEM

Infrastructure, Water and Environmental Management

MISSION

Knowledge Management and Networking for Indonesia's welfare

To contribute to the Indonesian people's welfare and their environments through combining of each member's excellence by:

- **Generating, mapping, sharing, dissemination and application of knowledge.**
- **Serving government institutions, private sector and professionals in the field of infrastructure, water and environmental management.**
- **Developing knowledge in conformity with and orientated to requirements of stakeholders working in the field of infrastructure, water and environmental management.**

Network Founding Members

Andalas University
IWRM, Irrigation Management, Natural Resource Management, Water Resource Management

Hassanudin University
Coastal, Waterfront City, Irrigation Management, Public Policy, Regional Planning, Social Institution, Water Resource Management, Water Quality Management

Bina Nusantara University
Information and Communication Technology / Computer Studies

Sepuluh November Institute of Technology
Coastal Engineering, Drainage, Irrigation Management, River Engineering & Management, Water Resource Management

Gadjah Mada University
Coastal Engineering, Disaster Management, Environmental Engineering & Management, Flood Management, Infrastructure Management, Irrigation Engineering & Management, Water Resource Engineering & Management

Bandung Institute of Technology
Environmental Engineering & Management, Irrigation Management, River Basin Planning, Water Resource Engineering & Management

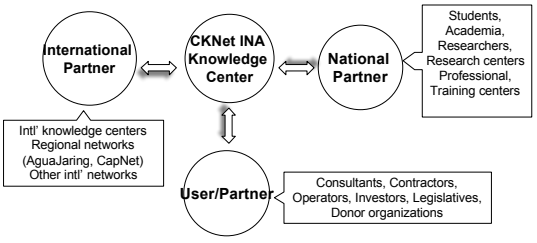
University of Indonesia
Environmental, GIS, River, Sanitation, Transportation, Water Resource Management

Merdeka University of Malang
Environmental Management, Water & Sanitation

Parahyangan Catholic University
Infrastructure Management, Public Policy and Management, Transportation Engineering

Diponegoro University
Coastal, Dam, Drainage, Flood, Irrigation, Water Resource Management

CKNet-INA as Knowledge Center in IWEM



WRIM Project

(Supporting Institutions: Nuffics, UNESCO-IHE, PT IHE-Indonesia)

Focus theme:
Water Resources and Irrigation Management

Focus on universities that have WRIM related subjects in their programmes and human resources with relevant experiences.

1. Institut Teknologi Sepuluh Nopember - Surabaya
2. Institut Teknologi Bandung – Bandung
3. **Universitas Gadjah Mada (UGM) Yogyakarta**
4. Universitas Hasanuddin - Makassar
5. Universitas Andalas - Padang

WRIM Project

Water Resources and Irrigation Management

Project Objectives:

1. To support the development of the CKNet-INA Knowledge Network and Knowledge Base in the field of WRIM
   Output: **A sustainable network**
2. To develop and strengthen a decentralized Capacity Builder's Training Capacity & Delivery System in WRIM
   Output: **Identified Capacity Building Needs & Programs for the Universities**
3. To develop and deliver demand oriented WRIM Course programmes and related modules
   Output: **Identified Training Needs in the water sector, and short course development & delivery based on needs**

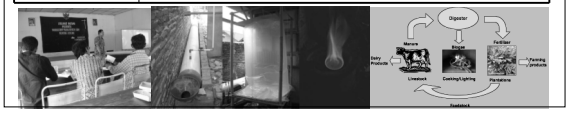
CKNet-INA

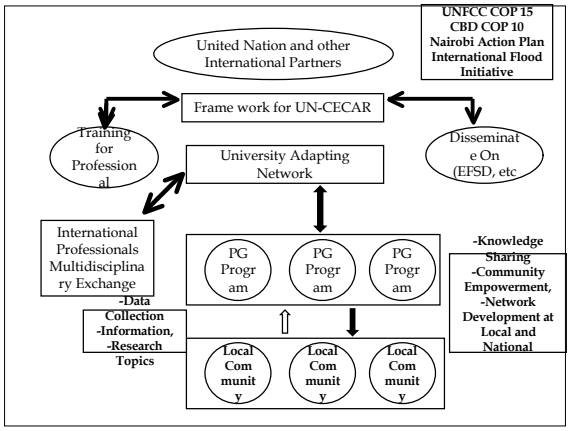
Geographic Spread

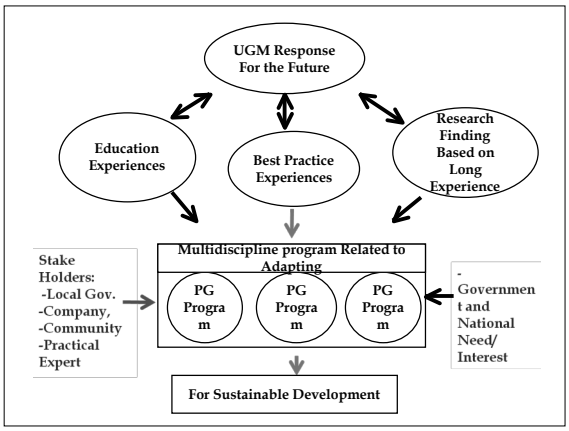
Best practices of climate change adaptation : community empowerment

Small industry ecosystem

Year	**2005 - now**
Location	**Samigaluh, Kulon Progo District , Yogyakarta**
Program	**Linkage of several small industries (essential oil industries, tofu industries, fish pond) in term of cross-utilization of energy, water and waste**
Result	**Energy saving, waste minimization, water saving, economy impact**
Student involvement	**90 undergraduate students (3 period of student community service program)**







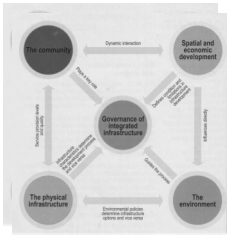
Best practices of climate change adaptation : education

Master of Engineering System in Resource Engineering

Year	2007-now
Program	The program emphasizes on understanding natural resources potentials, its management, methods and system of utilization, and its social and environmental impact.
Competency	Graduates has profound knowledge on natural resource potentials (water, land and earth resources, mineral resources) and capability on managing and utilizing the natural resources in a systematic and sustainable way.
Period	Four semesters incl. master thesis with total length of study 24 months
Admission	Cum-laude holders fresh graduates and professionals.
International	Joint program between UGM-ITB (Indonesia) and Karlsruhe University, Germany.

Best practices of climate change adaptation : education :

Master Program in infrastructure management and community development



- **Four faculties are involved in this program:**
  - **Faculty of Engineering;**
  - **Faculty of Social science;**
  - **Faculty of Economic and Business;**
  - **Faculty of Geography**
- **In cooperation with ITC, Netherlands**

UNIVERSITAS GADJAH MADA INDONESIA www.ugm.ac.id | ITC THE INTERNATIONAL INSTITUTE FOR GEO-INFORMATION SCIENCE AND EARTH OBSERVATION THE NETHERLANDS www.itc.nl | KEYPOINT CONSULTANCY THE NETHERLANDS www.keypointconsultancy.nl | Funded by: EVD international business and cooperation www.evd.nl

Best practices of climate change adaptation : education

Master of Engineering System in Micro hydro/Renewable Energy

Year	2002-now
Program	The program emphasizes on understanding micro hydro and other renewable energy potentials (e.g. wind, solar), its management, techniques and system of energy conversion, and its social and environmental impact.
Competency	Graduates has knowledge on micro hydro and other renewable energy potentials and capability on managing and converting the resources in a systematic and sustainable way.
Period	Three semesters incl. master thesis with total length of study 18 months
Admission	Fresh graduates, professionals and government officers.
International	Student exchange program with Karlsruhe University, Germany.

Best practices of climate change adaptation : education

Master program in pollution prevention

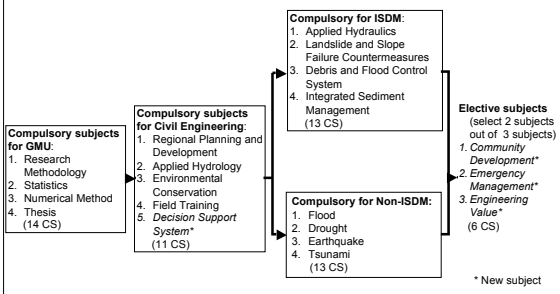
Year	2003-now
Program	The program emphasize pollution prevention rather end-pipe treatment through many ways such asusing chemicals which environmental friendly, zero emission /cleaner production, waste minimizing, recycle, etc
Competency	Students has capability to assess systematically and comprehensively environmental problems especially the ones related to process industries. Students has proper knowledge and skill in pollution prevention and industrial waste process.
Period	Three semesters incl. master thesis with total length of study 18 months
Admission	Fresh graduates and professional workers from industries
International	Student exchange program with Chalmers Univ. of Technology, Sweden

MASTER PROGRAMME IN NATURAL DISASTER MANAGEMENT (MPBA)

Sekretariat
Jurusan Teknik Sipil dan Lingkungan, Fakultas Teknik UGM
Jl. Grafika No. 2, YOGYAKARTA 58525
Telp. & Faks.: 0274-519788
E-mail: mpba@tsipil.ugm.ac.id
Website: http://mpba.ugm.ac.id/

TARGET OR GOAL OF THE PROGRAM IMPLEMENTATION

Graduates should enable to analyze and apply integrally the technical aspects (engineering theory, empirical formula, etc.), and non-technical aspects (socio-economic, environment etc.), to handle the problem of natural disaster management.



CURRICULUM DEVELOPMENT FOR MPBA PROGRAM

Existing Gaps

- University-Community linkage need to be strengthened
- Gaps between designed curricula and real problems
- Top down approach and bottom up approach should be more synchronized.
- Multidisciplinary and integrated approaches need to be strategically designed.
- Adaptation and understanding on climate change issue has not been yet fully developed as inter-disciplinary approach.
- Sustainability of the programs need to be improved.

Concluding Remarks and Possible Opportunities for Collaboration

- **Climate change is realized as a global issue, and thus international cooperation must be accelerated. There should be mutual understanding and cooperation between developed and developing countries in addressing climate change.**
- **Building a regional and international network of various disciplines that allows sharing knowledge and experiences is an important element in addressing climate change issue.**
- **UGM has strong concern on the issue and put efforts to drive community participation. UGM is ready to share its experience in community empowerment and network development in addressing climate change in term developing joint program / sandwich program / dual degree program at master level.**
- **Community empowerment – based on education and research is one of strategic approaches in addressing climate change. Higher education should be able to transfer and apply their knowledge and experience into the society.**