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Higher Education for Climate and Ecosystems Change

Adaptation Asia

Proceedings of the Consultative Conference and Workshop held in Tokyo, Japan, 10-12 June, 2009

First Consultation Conference on

Role of Higher Education in Adapting to Climate and Ecosystems Change

Edited by

Srikantha Herath

Akhilesh Surjan

UNITED NATIONS UNIVERSITY
UNU-ISP

IR3S
Integrated Research System for Sustainability Science

THE UNIVERSITY OF TOKYO

Institute for Sustainability and Peace
The United Nations University
53-70, Jingumae 5-chome, Shibuya-ku
Tokyo 150
Japan

Tel: +81-3-5467-1212
Email mbox@hq.unu.edu

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PREFACE

Barring few skeptics, climate change is now universally accepted as the most daunting challenge of this century and beyond. The importance and urgency to deal with climate change is rightly pointed out by the UN Secretary-General Ban Ki-moon by calling climate change a "defining issue of our era". Journey from COP-1 (Berlin, 1995) to COP-15 (Copenhagen, 2009) is an awakening one. Started with the principle of "common but differentiated responsibilities" during COP-1, now COP-15 is set to "establish an ambitious global climate agreement for the period from 2012". In other words, the world community is moving swiftly from 'negotiation-mode' to 'action-mode'. Moreover, actions toward this are going to be short, medium as well as long term and calls for sustained intervention. This essentially requires - knowledge generation, capacity development and knowledge transfer for climate change. Eventually, it urges to earnestly revisit higher education sector to address knowledge gaps especially in adapting to climate change.

While engaging key partners and prominent higher education networks, United Nations University is constantly advocating for universities of developing countries to maximize the benefits from opportunity to adapt, to build research and education capacities.

There is a long term endeavour beginning with this consultation conference organized in Tokyo in June 2009. In principle, adaptation is not a 'static destination' but a 'dynamic process'. Imparting adaptation focused teaching to present and future graduates and offering them right skills and tools to help their own communities to adapt is a prerequisite to sustain development process. This conference also helped catalyzing local universities and research agencies to work hand-in-hand with national, regional and international counterparts to facilitate sharing of knowledge and experiences.

There are specific reasons to focus on higher education (post graduate level) sector. Firstly, environmental education (which provides foundation to later understand climate change) is an integral part of the school curricula in most nations. Undergraduate focus on climate change adaptation can be introduced as a compulsory course lead to a deaper understanding of the concepts. However, it is graduate level where students work on specific tools, techniques, methods and application oriented problems which are of relevance to society. UNU has long been categorically targeting this group through various networks and initiatives and this is the right time to further it with a renewed vigor and larger partnership in the context of climate change adaptation.

COP 15 is expected to guide future course of actions toward mitigation and adaptation to climate change. It is very important for 'universities as knowledge-leaders' to reposition themselves to offer unique, innovative,

much needed solutions to climate problems. Limited or absence of capacities, skills, and know-how in most vulnerable parts of the world is recognized as one of the biggest constraints to overcome adverse impacts of the climate change. Adaptation to climate change, which is the only option available to many countries in Asia and Africa, are looking for systematically enhancing the capabilities of present and future generations to learn to adapt. Thus higher education is an area where universities are best placed to take lead in the climate change.

Adaptation to climate change is very much a localized action. Solutions to overcome climate change adverse impacts have to be developed locally, supported by global knowledge and experiences. However, top-down approaches that assume adaptation will occur without addressing how to implement specific actions are bound to fail as expressed by many practitioners, researchers and NGOs. Following specific activities are needed in developing adaptation strategies.

1. Generating local weather patterns by downscaling global climate change forecasts

2. Assessing impacts on sectors of interest for the expected weather patterns

3. Developing a menu of climate-specific adaptation options and rank them accordingly based on criteria selected by the researcher;

4. Comparing adaptive capacity/vulnerability across systems based on aggregate measures of vulnerability;

5. Assessing the appropriateness of these measures in relation to national development plans so that they can be mainstreamed;

6. Developing practical bottom-up adaptation strategies that can be implemented to address adaptive needs.

This conference and follow up actions are expected to influence policy makers to invest in higher education. It is expected that enhanced investment will lead to focused local research and education and help in wise-adaptation. In the near future, following are perceived as major outcomes of this network on climate change adaptation :

1. Educational program for climate change adaptation with curriculums for each major component covering various disciplines. Higher educational institutions would be able to mix different modules to suit various degree programs.

2. Mechanisms to share or exchange credits among participating universities.

3. A repository of research results on climate change adaptation from various countries.

4. A common research agenda to avoid duplication and compliment research on climate change adaptation for the region.

5. Establishment of linkages among research needs with available resources at various organizations for efficient resource sharing and research.

6. Theoretical framework for 'Adaptation Science' linking 'Sustainability Science' and 'Societal/Institutional resilience'.

7. A large number of specialists on climate change adaptation trained.

8. Efficient use of global development assistance in implementing development programs with climate change resilience through appropriate programs implemented supported by enhanced local capacity.

During 10-12 June, 2009, representatives from more than 18 universities and research organizations from across the Asia-Pacific, as well as international and intergovernmental organizations, gathered at UNU headquarters in Tokyo to put higher education on top of the climate change adaptation agenda. The first of its kind in the region, the three-day event entitled 'The Role of Higher Education in Adapting to Climate Change' was jointly organized by the UNU Institute for Sustainability and Peace, and the Institute for Integrated Research System for Sustainability Science (IR3S) of the University of Tokyo. The event successfully established a regional network that will provide the foundations for a comprehensive postgraduate educational programme to produce the necessary students, educators, and research needed for effective adaptation to climate change. More than 100 educators, researchers, policy makers and administrators participated.

The first day of the event, June 10, was a public conference featuring four keynote speakers: Prof. Janette Lindesay, Deputy Director, Australian National University Climate Change Institute; Prof. Diqiang Li, Director, Chinese Academy of Forestry; Prof. Nobuo Mimura, Director, Institute for Global Change Adaptation Science; and Prof. Hiroyuki Yoshikawa, Director-General for The Center for Research and Development Strategy, Japan Science and Technology Agency. Panelists were drawn from presidents, deans and heads of departments from leading universities in Japan, Sri Lanka, South Korea, India, Malaysia, Vietnam and Indonesia.

This booklet comprises summary highlights of key note addresses and panel discussions of the first day. The presentations and discussions of the second and third days of the workshop are available at http://unufms.net

We would like to thank contributors, panelists, participants for valuable contributions. Special appreciation goes to Ms. Yuriko Aoyanagi, Dr. Shimako Takahashi, Ms. Hiroko Nakazawa, Mr. Hideyuki Konishi, Ms. Alva Lim, Dr. Wang Yi, Ms. Jintana Kawasaki, Mr. Miguel Castaneda, Dr. Hidayat Rahman, Ms. Lenka Sedlakova, Mr. Shinsuke Kashikura, Ms. Myung Kyung Chung in successful organization of this Conference and Ms. Sidat Atapattu and Ms. Ayako Iizumi for helping in the preparation of this manuscript.

Srikantha Herath

Akhilesh Surjan

Institute of Sustainability and Peace, United Nations University

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CONFERENCE OVERVIEW

OUTLINE

During 10-12 June, 2009, representatives from more than 18 universities and research organizations from across the Asia-Pacific, as well as international and intergovernmental organizations, gathered at UNU headquarters in Tokyo to put higher education on top of the climate change adaptation agenda. The first of its kind in the region, the three-day event entitled 'The Role of Higher Education in Adapting to Climate Change' was jointly organized by the UNU Institute for Sustainability and Peace, and the Institute for Integrated Research System for Sustainability Science (IR3S) of the University of Tokyo.

The event successfully established a regional network that will provide the foundations for a comprehensive postgraduate educational programme to produce the necessary students, educators, and research needed for effective adaptation to climate change. More than 100 educators, researchers, policy makers and administrators participated.

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During the two-day closed workshop that followed, participants shared information on existing education-related teaching and research within their institutions, with the final day dedicated to brainstorming innovative ideas for a regional curricula, joint research projects and resource sharing, as well as future action plans. The conclusion of the event was a round-table commitment to further develop this initiative, with follow-up workshops to be held this year in Vietnam (August), Ghana (October), and next year in Indonesia.

CONFERENCE PROGRAMME

DAY ONE, 10 June 2009

10:00 – 10:30	Registration	
10:30 - 11:30	OPENING (Master of the Ceremony: Prof. Srikantha Herath, UNU-ISP)	
	Brief introduction to the programme	Prof. Srikantha Herath, Senior Academic Programme Officer, UNU-ISP
	Opening remarks	Prof. Konrad Osterwalder, Rector, UNU Mr. Isao KISO, Director-General, International Affairs, MEXT, Government of Japan
	Climate change and Sustainability	Prof. Kazuhiko Takeuchi, UNU-ISP & IR3S
	Climate change initiatives	World Bank: Mr. Kazushige Taniguchi, Special Representative, the World Bank Tokyo Office GEOSS/AWCI: Prof. Toshio Koike, the University of Tokyo
11:30 – 11:50	Coffee Break	Reception Hall, 2nd Floor, UNU
11:50 – 12:35	Keynote speech 1 Conceptualizing adaptation	Dr. Janette Lindesay, Deputy Director, Australian National University Climate Change Institute, Australia
12:35 – 12:45	Discussion, Q&A	Open
14:00 – 14:45	Keynote speech 2 Climate Change Impacts and Adaptation needs	Prof. Diqiang Li, Institute of Forest Ecology, Environment and Protection; Chinese Academy of Forestry, China
14:45 – 15:30	Keynote speech 3 Mainstreaming Adaptation to Development planning	Prof. Nobuo Mimura, Director, ICAS Professor, Center for Water Environment Studies Vice President Extraordinary, Ibaraki University
15:30 – 15:40	Discussion, Q&A	Open
15:40 – 16:00	Coffee	Reception Hall, 2nd Floor, UNU
16:00 – 16:45	Keynote speech 4 Sustainability Science for Action	Prof. Hiroyuki Yoshikawa, Director-General, The Center for Research and Development Strategy (CRDS), Japan Science and Technology Agency (JST)
16:45 – 16:55	Discussion, Q&A	Open

17:00 – 18:00	Panel Discussion: Climate Change Adaptation – Challenges and Opportunities for higher education Facilitated by Prof. Akimasa Sumi, Executive Director, TIGS, IR3S, the University of Tokyo • Prof. S. B. S. Abayakoon, Dean, Faculty of Engineering, University of Peradeniya, Sri Lanka • Prof. Mazlin bin Mokhtar, Director, Institute for Environment and Development (LESTARI), Universiti Kebangsaan, Malaysia • Prof. U. C. Mohanty, Center for Atmospheric Science, IIT, Delhi, India • Prof. Soontak Lee, President, International Association for Environment and Hydrology, Distinguished Professor, Yeungnam University, Korea • Prof. Mai Trong Nhuan, President, National University of Viet Nam, Viet Nam • Prof. Sudip Kumar Rakshit, Vice-President, Asian Institute of Technology, Thailand • Prof. Ir. Tumiran, Head, Faculty of Engineering, Gadjah Mada University, Indonesia	
18:00 – 18:25	Discussion, Q&A to the panelists	Open to the floor
18:25 – 18:30	Closing remarks	Prof. Akimasa Sumi, Executive Director, TIGS, IR3S

DAY TWO, 11 June 2009

The second day is dedicated to sharing experiences. All invited universities have been sent a questionnaire to summarise their existing climate-related teaching and research. Each faculty will present their experiences as well as needs and expectations in relation to two broad categories:

1. Educational programmes:
    a) Joint or dual degree programmes.
    b) Common courses open for credit sharing schemes.
2. Research programmes:
    a) Resource sharing such as experimental fields, experimental facilities, modeling and forecasting systems, short-term training, etc.
    b) Frameworks for joint research programmes, existing and proposed initiatives, available funds and fundraising activities, etc.

9:30 - 9:40	Opening and Introduction to the Programme
9:40 - 12:00	Chair: Prof. Kazuhiko Takeuchi, Vice-Rector, UNU University Presentation (presentations 15 min each)

- Prof. Mai Trong Nhuan, President, National University of Viet Nam
- Prof. Sudip Kumar Rakshit, Vice-President, Asian Institute of Technology, Thailand
- Prof. Guillermo Q. Tabios III, Head, National Hydraulic Research Center, University of the Philippines
- Prof. Ir. Tumiran, Head, Faculty of Engineering, Gadjah Mada University, Indonesia
- Prof. Mazlin bin Mokhtar, Director, Institute for Environment and Development (LESTARI), Universiti Kebangsaan, Malaysia
- Prof. Soontak Lee, Yeungnam University, Korea
- Prof. S. B. S. Abayakoon, Dean, Faculty of Engineering, University of Peradeniya, Sri Lanka
- Prof. Mafizur Rahman, Department of Civil Engineering, BUET, Bangladesh

12:00 - 13:00	Lunch

13:00 - 16:00 Chair: Prof. Mai Trong Nhuan, President, National University of Viet Nam
University Presentation (Japan) (presentations 15 min each)

- Prof. Toshio Koike, Department of Civil Engineering, University of Tokyo, Japan
- Prof. Kaoru Takara, Deputy Director, Disaster Prevention Research Institute, Kyoto University, Japan
- Prof. Shunji Matsuoka, Graduate School of Asia-Pacific Studies, Waseda University
- Prof. Monte Cassem, President, Ritsumeikan Asia Pacific University
- Dr. Ai Hiramatsu, Integrated Research Systems for Sustainability Science (IR3S)
- Prof. Hiromichi Fukui, Faculty of Policy Management, Research Director, Global Security Research Institute, Keio University

16:00 – 16:15 Coffee Break

16:15 - 18:45 Chair: Prof. Kaoru Takara, Deputy Director, Disaster Prevention Research Institute, Kyoto University, Japan
International /Research Organizations (presentations 15 min each)

- Asia-Pacific Network for Global Change Research (APN), Dr. Linda Stevenson, Scientific Officer
- Asian Development Bank Institute (ADBI), Dr. Anbumozhi Venkatachalam, Capacity Development Specialist, CBT
- International Cooperation Agency (JICA), Dr. Sudo Tomonari, Advisor, Climate Change Office
- Japan Aerospace Exploration Agency (JAXA), Dr. Chu Ishida, Director, Space Cooperation Office for Asia Pacific Region
- Institute for Global Environmental Strategies (IGES), Dr. SVRK Prabhakar, Policy Researcher, Climate Policy Project
- Dr. John Colvin, Director, Learning to Live with Climate Change Programme, the Open University
- Prof. Janette Lindesay, Deputy Director, Australian National University Climate Change Institute, Australia

DAY THREE, 12 June 2009

This day is dedicated for discussions to develop commitments, future action plans, phased deliverables, a network and cooperation framework.

09:30 - 10:30	Chair: Prof. Sudip Kumar Rakshit, Vice-President, Asian Institute of Technology University Presentation (presentations 15 min each) • Prof. U. C. Mohanty, Center for Atmospheric Science, IIT, Delhi, India • Prof. Rabindra Nath Shrestha, Head, Department of Civil Engineering, Institute of Engineering, Nepal • Prof. Diqiang Li, Institute of Forest Ecology, Environment and Protection, Chinese Academy of Forestry, China • Prof. Srikantha Herath, United Nations University – Institute for Sustainability and Peace
10:30 - 10:40	Summary of presentations: Curricula and courses
10:40 - 10:50	Summary of presentations: Joint research & resource sharing
10:50 - 11:10	Discussion
11:10 - 11:30	Coffee break
11:30 - 13:30	Break-out group discussion • Group A: Focus on joint research and resource sharing • Group B: Focus on curricula and course module development
13:30 - 14:30	Lunch
14:30 - 15:00	Presentation of group discussions
15:00 - 15:30	Establishing a framework, commitments and responsibilities
15:30 - 15:45	Agenda, date & venue for next workshop on implementation
15:45 - 16:00	Vote of thanks and Closure

PARTICIPANTS

Universities(21 universities from 14 countries)

1. National University of Viet Nam, Viet Nam
2. Asian Institute of Technology, Thailand
3. Faculty of Engineering, Gadjah Mada University, Indonesia
4. Department of Civil Engineering, University of Tokyo, Japan
5. Climate Change Institute, Australian National University, Australia
6. Institute of Forest Ecology, Environment and Protection, Chinese Academy of Forestry, China

7. Center for Water Environment Studies, Ibaraki University, Japan
8. Faculty of Engineering, University of Peradeniya, Sri Lanka
9. Institute for Environment and Development (LESTARI), Universiti Kebangsaan, Malaysia
10. Center for Atmospheric Science, Indian Institute of Technology, Delhi, India
11. International Association for Environment and Hydrology / Yeungnam University, Korea
12. Department of Civil Engineering, Institute of Engineering, Nepal
13. National Hydraulic Research Center, University of the Philippines
14. Department of Civil Engineering, Bangladesh University of Engineering and Technology, Bangladesh
15. Graduate Program on Sustainability Science/IR3S/TIGS, University of Tokyo, Japan
16. Disaster Prevention Research Institute, Kyoto University, Japan
17. Graduate School of Asia-Pacific Studies, Waseda University, Japan
18. Ritsumeikan Asia Pacific University, Japan
19. Faculty of Policy Management, Global Security Research Institute, Keio University, Japan
20. Learning to Live with Climate Change Programme, Open University, UK
21. Institute of Sustainability and Peace, United Nations University (Secretariat)

International /Research Organizations

1. Asia-Pacific Network for Global Change Research (APN)
2. Asian Development Bank Institute (ADBI)
3. International Cooperation Agency (JICA)
4. Space Cooperation Office for Asia Pacific Region (SCOAP), Japan Aerospace Exploration Agency (JAXA)
5. Climate Policy Group, Institute for Global Environmental Strategies (IGES)

Supporting organizations

1. Ministry of Education, Culture, Sports, Science and Technology (MEXT), Government of Japan

2. The World Bank, Tokyo Office

3. The Center for Research and Development Strategy (CRDS), Japan Science and Technology Agency (JST)

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PURPOSE AND BACKGROUND

WHY ADAPTATION?

Adaptation to climate change has emerged as one of the most important concerns in global development agenda. This stems from a growing consent that climate change is occurring now mainly as a result of human activities (IPCC AR4) related to GHG emissions and the realization that even with effective mitigation actions across the globe, already existing GHG in atmosphere will lead to significant changes in future climate.

Adapting to change is not a new endeavor. It is practiced widely, especially in natural resources management or disaster risk reduction fields, while in the climate change debate, adaptation has taken a back seat in the search for a globally accepted binding agreements on mitigation to reduce GHG gas levels to acceptable levels.

Adapting to climate change, however, differ from the other types of adaptation practices in several ways. Firstly there is still a great deal of uncertainty on climate change, related to the rate of change, its causes and the influence of various other mechanisms of earth system that are not explicitly considered in the forecasting models. Secondly, the climate change is a gradual processes making it difficult to notice the changes until the accumulated impacts become significant. Thirdly, there is a difficulty in relating the climate change predictions made at global scale with coarse spatial resolutions with fine local spatial resolutions required to correlate with past observations and its relation to future weather changes that is essential in assessing impacts on various livelihood sectors. Adaptation in natural sciences is often linked with the concept of risk where both hazard and vulnerability play an important role. In social sciences and climate change field, adaptation is associated more with vulnerability and even then, vulnerability is used in different ways. To social scientists, vulnerability is focused on the socio-economic factors that influence the human system's ability to cope with stress or change; whereas for climate scientists, vulnerability is the likelihood of occurrence and impacts of weather and climate related events.

ADAPTING TO WHAT?

The fourth IPCC assessment report describes adaptation as a process that takes place through adjustment to reduce vulnerability and enhance resilience. This implies that adaptation is not only to reduce risks

due to global changes but also to make use of as an opportunity to improve. Adaptation, thus, need not be restricted to mitigate adverse impacts of expected climate change, but rather as an opportunity to reduce vulnerability and improve coping capacity as a no-regrets development strategy. However, this requires setting goals for adaptation. Should we aim for completely 'climate-proofing' (or climate-independent) our societies in the longer term? Some may say we shouldn't even focus on adaptation at all, rather development first, which will indirectly solve the adaptation challenge. In this regard, what we need is a critical debate on what is needed to adapt and what are we trying to adapt to? Once these goals are identified, it is necessary to work backward to identify feasible strategies for a particular sector. Such policy-focused approach, which identifies participants/stakeholders goals first offers a robust and flexible method for policy development and allows for multidisciplinary efforts to occur.

HOW TO ADAPT?

Considering need to mitigate climate change impacts as well as to make use of the opportunity to improve livelihoods, it is clear that adaptation strategies should be designed within the context of the national development plans and there need to be a long term vision within which short term strategies can be developed. As adaptation studies expanded, many forms and levels of adaptation have been identified. These are (but not limited to)

- Vulnerability (which in itself is a function of exposure, sensitivity, and adaptive capacity);
- Approach (natural hazards or risk approach, vulnerability approach, adaptive capacity or resilience approach, or policy approach)
- Relative timing of adaptation measures (anticipatory, concurrent, or reactive to climate stimulus);
- Intent (autonomous or planned);
- Spatial scope (top-down or bottom-up, local, sectoral, national, regional and sub regional);
- Form (micro-level, market responses, technological, behavioral, financial, institutional, informational); and
- Degree of adjustment or change required from (or to) the original system (incremental or substantial);
- The minimum level of adaptation should accommodate adverse impacts of climate change. The steps involved in adaptation strategy design could be different depending on the intent or purpose, but would basically entail the following;

- Generating local weather patterns by downscaling global climate change forecasts
- Assessing impacts on sectors of interest for the expected weather patterns
- Developing a menu of climate-specific adaptation options and rank them accordingly based on criteria selected by the researcher;
- Comparing adaptive capacity/vulnerability across systems based on aggregate measures of vulnerability;
- Assessing the appropriateness of these measures in relation to national development plans so that they can be mainstreamed;
- Developing practical bottom-up adaptation strategies that can be implemented to address adaptive needs.

ROLE OF HIGHER EDUCATION

Adaptation to climate change is very much a localized action. It depends on the local hydro-meteorological, geo-physical and socio-economic conditions. Solutions to overcome climate change adverse impacts have to be developed locally supported by global knowledge and experiences. Top-down approaches that assume adaptation will occur without addressing *how* are bound to fail as expressed by many practitioners, researchers and NGOs. For adaptation strategies to evolve locally, local capacity development is essential, especially in the developing countries, to customize available global knowledge for local conditions. This needs to be done in postgraduate education where necessary research can be conducted in applied research projects in partnership with implementing agencies and local communities. Higher education segment of the society has an important role to play in giving direction and leadership in assessing climate change impacts and establishing appropriate frameworks where affected communities can work with specialists in developing appropriate strategies.

RESEARCH NEEDS

The IPCC Working Group II (2007) identifies the following key priorities, which must be addressed to narrow gaps between current knowledge, and policymaking needs *Source: IPCC Working Group II (2007)*:

- Quantitative assessment of the sensitivity, adaptive capacity, and vulnerability of natural and human systems to climate change, particularly changes in the range of climatic variation and the frequency and severity of extreme climate events.

- Assessment of possible thresholds at which strongly discontinuous responses to projected climate change and other stimuli would be triggered.

- Understanding dynamic responses of ecosystems to multiple stresses, including climate change, at global, regional, and finer scales.

- Development of approaches to adaptation responses, estimation of the effectiveness and costs of adaptation options, and identification of differences in opportunities for and obstacles to adaptation in different regions, nations, and populations.

- Assessment of potential impacts of the full range of projected climate changes, particularly for non-market goods and services, in multiple metrics and with consistent treatment of uncertainties, including but not limited to numbers of people affected, land area affected, numbers of species at risk, monetary value of impact, and implications in these regards of different stabilization levels and other policy scenarios.

- Improving tools for integrated assessment, including risk assessment, to investigate interactions between components of natural and human systems and the consequences of different policy decisions.

- Assessment of opportunities to include scientific information on impacts, vulnerability, and adaptation in decision making processes, risk management, and sustainable development initiatives.

- Improvement of systems and methods for long-term monitoring and understanding the consequences of climate change and other stresses on human and natural systems.

In addition to the above research topics, we need to consider some important issues on the characteristics of adaptation strategies and its implementation as;

1. Prioritization of adaptation

2. Inter-disciplinary approach

3. Innovations to support adaptation

4. Ultimate objective of adaptation – long term goals

Prioritization of adaptation relates to both research and policy, both of which are limited by financial, statistical, technological, modeling, and a range of other resources. Adaptation efforts must consider key questions such as:

- Given the constraints, how should governments and researchers prioritize adaptation efforts in order to achieve their stated goals, and based on what criteria (effectiveness, cost-benefits, justice, equity, gender, Human Development Index, etc)?

- What are the policy trade-offs between adaptation-mitigation, and adaptation-other priorities?

- Should adaptation be mainstreamed into other policy priorities or should additional layers be created?

While it is well understood that an *inter-disciplinary approach* is required in addressing adaptation to climate change, individual researchers tend to focus on their own research fields mainly due to lack of practical opportunities to carry out such research. It is important to create environments so that researchers from institutions of different disciplines can address the same field problem though joint programs. Building a regional network of institutions of various disciplines to address climate change adaptation is therefore an important element for developing successful adaptation strategies.

Innovations should be given a high priority in adaptation to climate change to capitalize on resources made available, political will and concentrated efforts of various stake holders in understanding local climate related impacts and developing effective solutions. A repository of various innovations being made in climate change field, and a mechanism to exchange experiences across regions is very much needed. Geo-engineering proposals should also be considered as a component of the search for innovative solutions.

Finally there is a need to discuss what the final target of adaptation should be in relation to human habitats. Will the current migration trends continue and the majority of population will finally settle down in mega cities, making building sustainable cities a priority? Will there be a continuum of urban landscape with varying densities spreading from highly concentrated mega cities to rural settlements? Should we select a future that can withstand variability of natural environment, including rain, floods and temperature, or would it be prudent to design infrastructure that are in harmony with nature and will adapt to variability rather than resist it.

The symposium is designed to discuss the above-mentioned topics and establish a network of institutions engaged in the higher education in the region that will develop a curriculum for climate change adaptation in the higher education sector.

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SESSION 1: OPENING AND OVERVIEW

OPENING REMARKS

Professor Konrad Osterwalder, Rector, United Nations University

Adaptation to climate change has emerged as one of the most important concerns in global development agenda. Adapting to change is not new – actually the capability to adapt is one of the conditions for survival of the human race. If changes occur very slowly, adaptation may happen almost automatically. Nowadays many things change quickly, seen on a cosmic scale, and adaptation has to be practiced widely with a systematic and scientific approach. Well known examples are the fields of natural resources management or of disaster risk reduction.

Figure 1: Prof. Osterwalder, Rector, UNU

However, surprisingly enough, in the climate change debate, adaptation has taken a back seat in the search for a globally accepted binding agreement on mitigation to reduce GHG gas levels to acceptable levels. Is this really surprising? I think it is not for two reasons.

If we put too much weight on the problem of adaptation, we run the risk of being seen as fatalists who have given up on mitigation – which would be disastrous.

While global warming is a truly global problem, adaptation has many local aspects, which may be dealt with locally, hence no global agreements are necessary

Having said this, one also has to admit, that our present knowledge tells us that global warming would continue even if we are successful in brining GHG emissions to acceptable levels because of the already existing gases in atmosphere, and therefore time has come for us to seriously discuss how we should address adaptation.

Adapting to climate change is different from the other types of adaptation practices in several ways.

Firstly there is still a great deal of uncertainty on climate change, related to the rate of change, its causes and the influence of various other mechanisms of earth system that are not explicitly considered in the forecasting models.

Secondly, climate change is a gradual processes making it difficulty to notice the changes until the accumulated impacts become critical.

Thirdly, there is a difficulty in relating the spatially averaged climate change predictions made at global scale to the fine local scale required to address local heterogeneity.

Adaptation in natural sciences is often linked with the concept of risk where both hazard and vulnerability play an important role. But in social sciences in the discussion of climate change, adaptation is associated with vulnerability, too, but vulnerability is used in different ways.

To social scientists, vulnerability is mainly focused on the socio-economic factors that influence the social system's ability to cope with stress or change, whereas for climate scientists, vulnerability is the likelihood of occurrence and impacts of weather and climate related events. It is clear that we need platforms to promote interdisciplinary interactions to fully make use of strengths of various disciplines to design appropriate adaptation strategies.

Adaptation to climate change depends on the local hydro-meteorological, bio-physical and socio-economic conditions. Solutions to overcome adverse impacts due to climate change, therefore, have to be developed locally and regionally, but of course supported by global knowledge and experiences. For adaptation strategies to evolve locally, local capacity development is essential, especially in the developing countries, to customize available global knowledge for local conditions.

This has to be done in postgraduate education where necessary research can be conducted through applied research projects in partnership with development agencies and local communities. The highly educated segment of society should give direction and leadership in assessing climate change impacts and establishing appropriate frameworks, frameworks where affected communities can work with specialists in planning appropriate strategies.

From 17th to 19th of May, 2009, I participated in the G8 University summit in Torino, Italy, where the Presidents, Rectors, Chancellors, Vice-Chancellors and representatives of leading educational and research

institutions in the G8 member gathered before the "L'Aquila 2009 G8 Summit" meeting of the Heads of States. The United Nations University as well as the leading universities from the Outreach 5 nations, and worldwide networks of international universities were also invited to participate to broaden the international contribution in tackling the issues facing humanity relating to sustainable and responsible development.

The 2009 University Summit acknowledged and stressed the pivotal role that higher education institutions and scientific research organizations should play in supporting sustainable and responsible development, both at global and local levels. The declaration, has adopted 4 principles and 4 engagements to promote sustainability principles in solving pressing global problems. Adapting to Climate Change is an important area where all these principles and engagements are extremely important. I am therefore very pleased to note the linkages already established between the adaptation platform initiative discussed here and the sustainability science approach through IR3S. Here, I would like to express my sincere appreciation of the excellent support provided by our co-organizers, the secretariat of the Integrated Research Systems for Sustainability Science at the University of Tokyo.

I would like to extend my sincere gratitude to the four speakers - Professor Janette Lindesay from Australian National University,; Professor Diqiang Li from Chinese Academy of Forestry; Professor Nobuo Mimura of Ibaraki University, and Professor Hiroyuki Yoshikawa of Japan Science and Technology Agency for kindly accepting our invitation deliver four keynote presentations.

I am also very much grateful to the presidents, vice presidents, deans and department heads and Representatives of 11 universities in the Asian region and the 5 Universities in the host country who have kindly accepted our invitation to join the workshop in designing a platform for adaptation research and capacity development.

Finally I would like to thank the international organizations who are have joined the workshop to share their valuable experiences with us.

I look forward to fruitful outcomes from this worthy endeavor.

MESSAGE FROM MEXT

Mr. Isao KISO, Director-General, International Affairs, MEXT, Government of Japan

Figure 2: Mr. Isao Kiso, MEXT

On behalf of MEXT Mr. Kiso expressed his pleasure on the organization of this Conference. He mentioned that the topic of the Conference is very important in order to create a sustainable society, but advised to also include perspectives from economy, society and political spheres in the ongoing dialogue on climate change. Towards this, he advocated for working towards a more inclusive and emerging need based definition to understand basic concepts of sustainability. He expressed his happiness that IR3S and UNU is jointly organizing this Conference. He also mentioned about 'Education for Sustainable Development (EfSD)' which he opined is essential to establish a sustainable society. He shares the concern for need to further strengthen capacity building and education efforts which he thinks are most important for EfSD. He informed that Japan has adopted UNESCO's 10 year EfSD Framework and noted UNU's important role in promoting EfSD in Africa as praiseworthy in this context. He appreciated UNU's regional centers on education for sustainable development and sustainable education which are contributing immensely towards building sustainable societies. He congratulated UNU's Rector for promoting both sustainability research and sustainability education by the creation of a new institute titled 'Institute of Sustainability and Peace' which is now preparing to offer educational programs on sustainability for master and doctoral course aspirants. He wished that the new institute will act as center of excellence and is looking forward to the inauguration of a very innovative program in the near future. He conveyed his best wishes to Prof. Takeuchi, Vice Rector of UNU and Director of the Institute and other international researchers of this new Institute for the success of its mission.

CLIMATE CHANGE AND SUSTAINABILITY

Prof. Kazuhiko Takeuchi, Vice-Rector, United Nations University Director, UNU-Institute for Sustainability and Peace Deputy Executive Director, University of Tokyo IR3S

Figure 3: Prof. Takeuchi, Director, UNU-ISP

Prof. Takeuchi focused his talk on climate change and sustainability and introduced UNU-ISP as a new institute. He informed that UNU-ISP became operational on 1st of January 2009 integrating former Environment and Sustainable Development and Peace and Governance Programs at the UNU in Tokyo to create trans-disciplinary synergies that can more effectively address pressing global problems of human survival, development and welfare. He mentioned that there are three major areas of intervention of this new Institute viz. - Global change and sustainability; Peace and security; International cooperation and development. However, adaptation to climate change will act as a major cross-cutting theme to all these three major areas. He opined that most strategies so far remain biased towards Green House Gas reduction. However, even if emission levels come down, the effects will be felt for a long time to come and hence adaptation to climate change must be planned in advance.

Prof. Takeuchi agreed that there is enormous complexity involved at local level adaptation and there are two specific challenges involved –

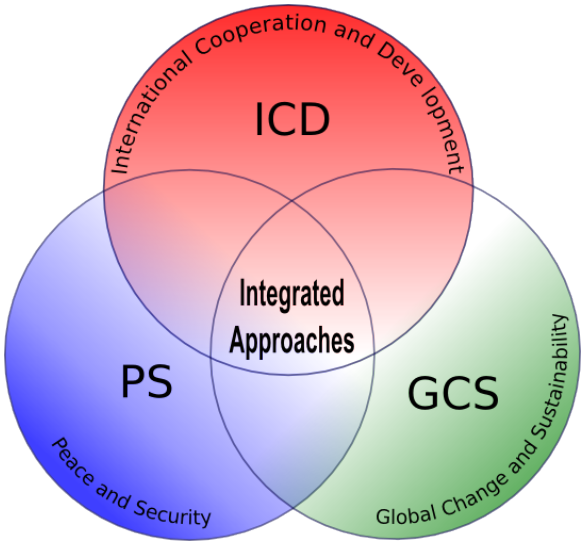

Figure 4: Integrated approach of UNU-ISP

1. It is difficult to tackle adaptation to climate change in isolation from development issues

2. How to incorporate uncertainty of climate change impacts in the development planning (where the magnitudes, rates and accuracy levels of impacts at local scales are largely unknown at present).

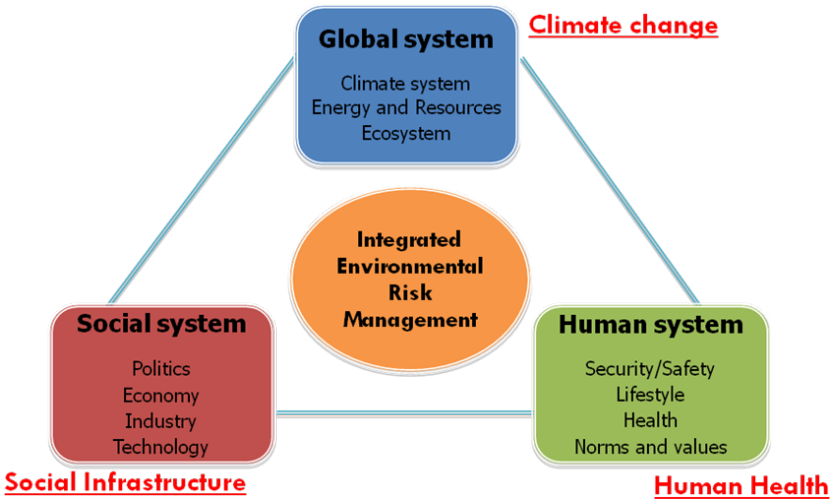

Figure 5: Linkages among three systems

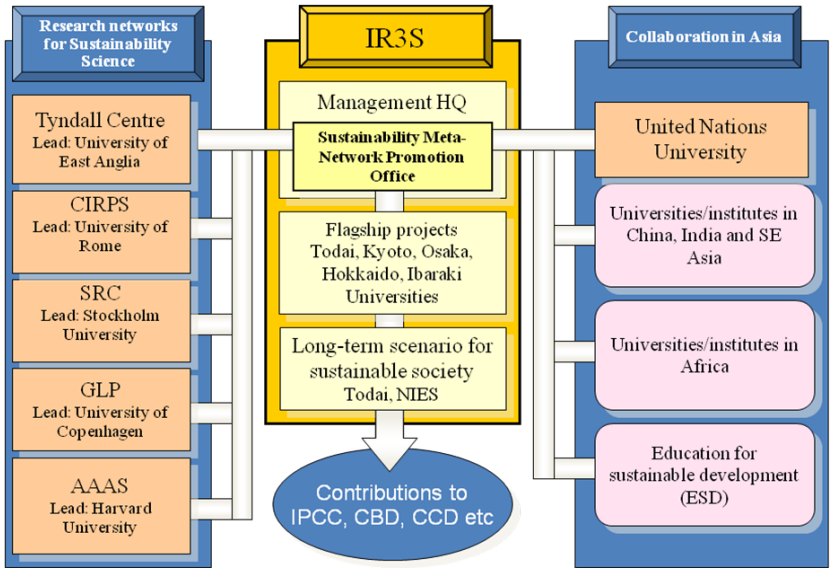

Figure 6: Sustainability Meta-Network

He suggested that the answer to these two concerns lies in building 'climate resilience' in parallel to developing a 'low carbon society'. He informed that the target of adaptation to climate change could be-

1. Future techno environment where we build our own nature and environment, while cutting us away from nature

2. In harmony with nature, which can be achieved through linkages of three systems viz. – global systems, human systems, and social systems. Integrated environmental risk management can help bringing these three together.

Talking about Sustainability science, Prof. Takeuchi informed that this is one of the most rapidly developing sciences today. Recognizing that we need social systems that co-evolve with technical systems, IR3S bring together 12 universities working towards sustainability issues. He expressed that adaptation to climate change is ultimately sustainability issue and therefore UNU-ISP will also become member of IR3S this year where methodological subjects on sustainability science will be addressed. He finished his talk by quoting that adaptation to climate change is an important milestone and it paves the way towards a truly sustainable society.

CLIMATE CHANGE INITIATIVES

World Bank: Mr. Kazushige Taniguchi, Special Representative, the World Bank Tokyo Office

Mr. Taniguchi focused his talk on climate change as a global development issue and was concerned that the developed world at present is too busy discussing ongoing financial crises. In the meantime, GHG is further accumulating while being ignored as priority. He mentioned that the World Bank believes that both adaptation and mitigation to climate change are important. Adaptation is crucial because the root cause of the problem lies with developed countries and the serious results are faced by the developing countries. It is a matter of fairness and has become a major issue of sustainable development. He expressed that climate change is similar to managing human health, assessing what is going to happen and thereby taking appropriate actions.

Figure 7: Mr. Taniguchi, Spl. Rep., World Bank

is much cheaper than rebuilding from scratch after disasters. He cautioned that due to economic crises, governments often cut budgets for infrastructure, which, in turn, results in the future impediments to sustainable growth. With further deepening of impacts of disaster due to climate change, we must prepare for the worst which necessitates global and local risk assessment, effective coordination and swift actions. Such tasks require concerted efforts of development practitioners, NGOs and academia. He emphasized that academia's role is particularly important to deepen the analysis and policy recommendation, and this Conference is a very timely initiative toward this end.

GEOSS/AWCI: Prof. Toshio Koike, Department of Civil Engineering, The University of Tokyo

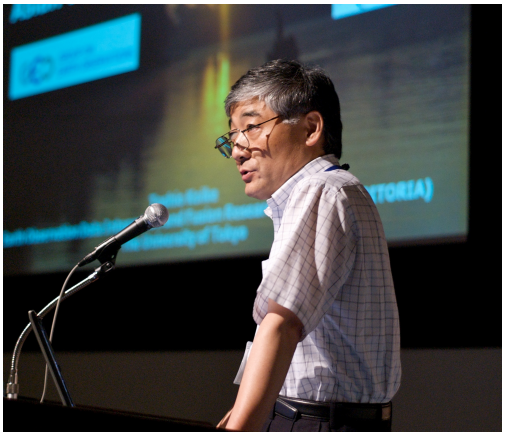

Figure 8: Prof. Toshio Koike, Univ. of Tokyo

Prof. Koike talked about Asian Water Cycle Initiative (AWCI) under the aegis of Global Earth Observation System of Systems (GEOSS) which is an initiative to promote integrated water resources management by making usable information from GEOSS, for addressing the common water-related problems in Asia. Group on Earth Observation was established in the year 2005 which enjoys now membership of 77 countries. The impact of climate change of water cycle is going to be very challenging with more floods and landslides, droughts, water pollution and ecosystem degradation. Especially water pollution and water scarcity which are already existing problems will further deepen due to climate change. He mentioned that AWCI enjoys support of 19 member countries who proposes one river basin and submit hydrological data. As a result, 18 river basins for initial demonstration are available. In addition, we need many other climatic and related data. AWCI is gathering observation data and in collaboration with 12 centres (including Japan Aerospace Agency) in the world in compiling the data. He informed that IPCC is compiling 24 climate models, which are all archived, and hence combining AWCI and IPCC data, we can provide useable information for climate change adaptation.

Prof. Koike shared that a recent study to assess climate change impacts on heavy rainfall was conducted. 80% models in the study suggested increase in inundation area, depth and damage - the information important for making decisions about adaptation to climate change. Another study in Bhutan uses satellite data and monitors Lake Surface and predicts inflow in glacial lake and offer early warning to policy makers.

Prof. Koike also introduced DIAS - Data Integration and Analysis System of Japan which collects data, achieve huge data, and offers system integration and applicability. He also shared that in Central Vietnam, by integrating numerical and satellite data, we can predict flood inundation, depth and evacuation instructions to policy makers. He also mentioned excellent UNU collaboration towards these initiatives where it is leading the capacity development activities with JAXA and that Dr. Herath conducted numerous capacity building activities utilizing AWCI to benefit Asian countries.

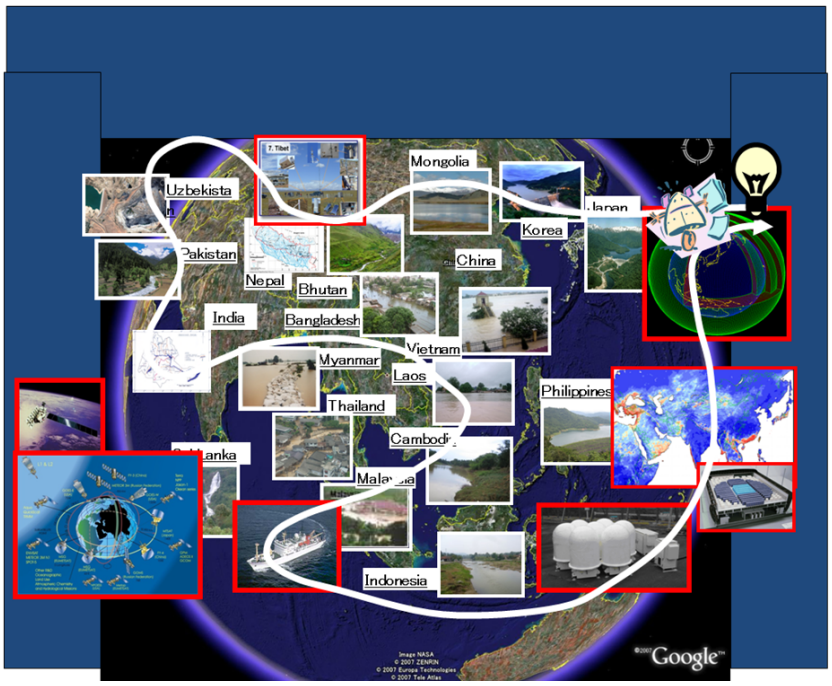

Figure 9: Asian Water Cycle Initiative

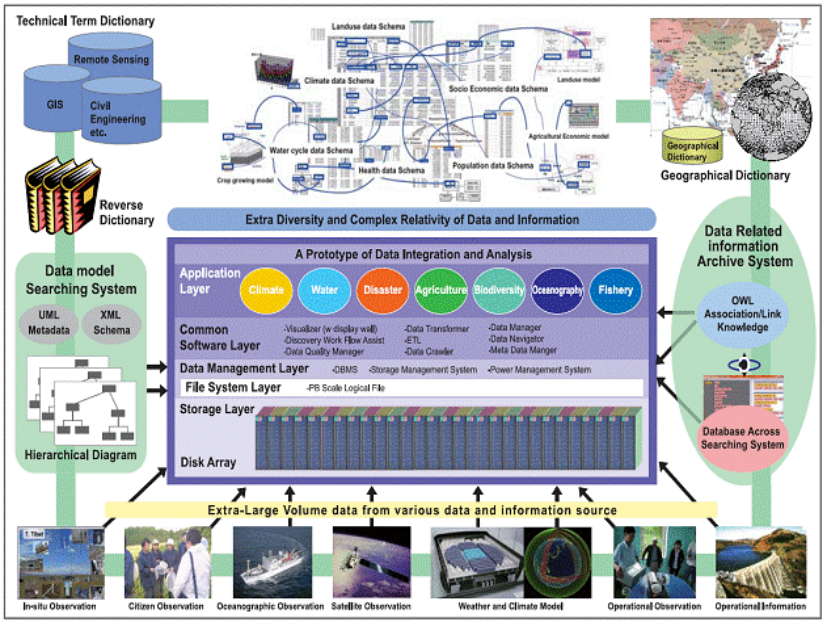

Figure 10: DIAS - Data Integration and Analysis System

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SESSION 2: KEYNOTE ADDRESSES

CONTEXTUALISING APPROACHES TO CLIMATE CHANGE ADAPTATION & MITIGATION

Dr. Janette Lindesay, Deputy Director, ANU Climate Change Institute, Australian National University

Figure 11: Prof. Janette Lindesay, ANU

In the beginning of her key note lecture, Dr. Lindesay gave a brief overview of science of climate change from the perspective of IPCC's 4th Assessment Report of 2007. She mentioned that we need keep in mind the fact that IPCC's work until now is based on peer-reviewed published literature. It might take about a year or more from submission of paper to the journals, getting it reviewed, and finally publishing. This means that lot of data appearing in the IPCC reports might even be several years old. In other words, the report published in 2007 also reflects data which is based on researches conducted four to five year prior. 2007 report is a first series of IPCC reports that talked about unequivocal evidence of climate system warming, very high confidence that emissions due to human activities leading to a very strong likelihood that anthropogenic green-houses gases increase have caused the observed warming since the middle of 20th Century. That information has been superseded in the year between then and now with more recent information on which Dr. Lindesay concentrated while emphasizing about the evidence of climate change. Most people must be familiar with the record of global temperature that is compiled by the Climatic Research Unit of the University of East Anglia, UK which shows clearly two substantial appearance of

warming in the record – one in the early half of the 20th century and second half of the 20th century starting in the late 1970s-round about 1980. And between those two, there is a period where warming slowed down during post-second World War through to 1980. It is interesting to look at the fact that we have experienced just less than 1 degree of overall warming. While the trend in the period from 1961 to 1990 and also the warming held in the early part of the 20th century described more due to as natural variability. Climate forcing as we know are many, they include - solar variations, aerosol loading in the atmosphere (a lot of which is not anthropogenic such as volcanoes) and natural climate variability. Since 1940's, there is not much changes in these non-GHG forcing, hence GHG emerge as the main cause for warming. Current levels of carbon dioxide is 375 parts per million with a very high presence of methane as well. Radiative forcing components include GHGs, Ozone (Albedo, LU, LC) aerosols, where net anthropogenic components far exceeds natural forcing.

Climate Change's rapidity is alarming and hence its impacts on biodiversity, human population and planetary system is more pronounced. Dr. Lindesay gave first key message on climate trends. She informed that in Copenhagen congress held in March 2009, experts talked about many changes that have accelerated and still accelerating like arctic summer, sea-ice extent –which is diminishing. She mentioned that sea-ice in the year 2007 was 25% less than 2006 and 38% below average and some experts fear that arctic will be ice free by 2015 which she believes is a too pessimistic observation. However, she agreed that we have crossed a tipping point average and we can see that since 1980, melting rates are high. Similarly between 1961 to 2003, sea level rise was 1.6 millimeter per year which has increased to 2.5 millimeter per year between the year 2003 and 2008. She further stated that even today, one meter sea level rise seems too conservative and it could easily be 1.2 meters which was also discussed in Copenhagen Congress. Great natural disasters of 2008 including hurricane Ike of USA, severe wind storm in China, cyclone Nargis of Myanmar and flooding in northern Australia although represents individual events but more important is the intensity and frequency with which they are occurring. Hence adaptation strategy needs to take into account gradual changes, sudden changes as well as crossing of the tipping points. IPCC modeling confirms that whatever we do, no significant change will be observed till the year 2025. However, by the year 2095 serious difference of 3-4 degree centigrade will be observed. It is difficult to relate to 2095 which is a very long way in to the future, but these should be done for our grandchildren.

As documented in Stern Review, impacts on food, water, ecosystems as well as occurrence of extreme weather events – by the end of this century it is going to be really very serious. Since the year 1992, we are committed to avoid dangerous climate change i.e. to keep below 2 degree centigrade heating. In Copenhagen Congress, Danish minister asked certain answers from scientists, where 2 degree centigrade was proposed as the limit. Precipitation change could be very rapid which will affect infrastructure, agriculture, and increase in dry days, extremes in precipitation, etc. While talking about vulnerability, risk

and adaptation, she mentioned water availability change and acknowledged IPCC's suggestion that the modeling of hydrological cycle is not as reliable as climate modeling. However it highlights the greater complicated concerns about precipitation, soil moisture, runoff, evaporation. Dr. Lindesay categorized vulnerability of water resources into three as, agriculture, urban areas, and environmental flows and argued that in addressing climate change it is essential to look at the context of sustainability and its framework in order to live in harmony with nature and to maintain the healthy environment, an ideal choice for the future. Ecosystems are vulnerable because of the fragmentation of landscapes which makes barriers to the species to migrate, of negative impacts on Invasive species, of changing disturbance regimes such as fire, and of direct effects of rising temperature. It can cause changes of sex ratios of reptile offspring for an instance. By providing a definition of vulnerability by B. Pittock, an Australian researcher, she mentioned that vulnerability is useful to identify groups, sectors or regions at risk. There is no sector in society that needs no adaptive structures for climate change although there would exist different ranges of impact they may face.

Thus the application of the concept of vulnerability as well as risk assessment and enhancing the adaptive capacities are essential. If the climate change brings a condition which exceeds a horizon of which people can adapt, in other words, if we stand outside our coping range with climate, disasters will result. Adaptive capacity as she quotes B. Piccock refers to the ability of a system to adjust to climate change including changes in variability and extremes. Identifying adaptive capacity is important because it allows targeted development of coping strategies to assimilate and deal with impacts. Then a comprehensive risk management is necessary. The rational process of risk management includes establishing priorities, identifying risks, analyzing, evaluating and treating them. She took an example of an agricultural business which simultaneously and constantly needs to pay attention to not only climate but also to market, labour, technology, government policy, legislation, international framework, etc. A better understanding of how to cope with vulnerability and use of technological advances will help to cope up.

Regarding the adaptation, which is, (according to B. Pittock), an adjustment in natural or human systems in response to actual or expected climate change, she emphasized the various types of possible adaptations approaches as anticipatory, reactive, public, private, autonomous or planned. She also stressed the importance of asking about socio-economic instruments to develop appropriate instruments while maintaining that the basic research is still necessary. Resilience can be defined as the capacity to deal with change and continue to develop according to the Stockholm Resilience Centre. She regards that it is not for the maintenance of the status quo because the keen attention on the idea of change is imperative. It also calls for the necessity to cope with and pay attention to indirect impacts, abrupt changes and surprises. She took examples of a series of natural disasters in Australia, all of which occurred within a year which were both extreme flooding and fire. Such disasters (risks) are often non-linear, have different time lags

and thresholds, transforms rapidly. As tipping points, state changes in critical functioning aspects of the eco-system may occur. Therefore more organized approach to adaptation is required.

She warns that the emissions gap curb has been increasing and that we must curb down the gap if we were to stabilize the GHGs at 450 parts per million (ppm). The greater the emissions gap gets, the harder to arrange the new strategies for adaptation. A survey by the United Kingdom's MET Office shows that if we take early but slow declining actions, a temperature will rise between 3-4 degrees by 2100. If we are to achieve the temperature rise by 2 degrees by 2100 we have to take early and urgent declining actions. The EU's 2-degree Guardrail shows risks will increase in many fields; risks to unique and threatened systems, of extreme weather events, distribution of impacts, aggregate impacts, and risks of large scale discontinuities. She admits that, given the uncertainties of climate change projections and the possibility of abrupt changes, enhancing adaptive capacity or resilience is a robust approach that it must be based on best-practice scientific knowledge. Local knowledge and approaches are also essential. She concluded her speech by stressing the importance of education for the next generation of policy makers, scientists, and civil society leaders.

CLIMATE CHANGE IMPACTS AND ADAPTATION NEEDS

Prof. Diqiang Li, Institute of Forest Ecology, Environment and Protection; Chinese Academy of Forestry, China

Figure 12: Prof. Diqiang Li

First part of key note lecture by Prof. Li focussed on the main findings of IPCC's AR4 while emphasizing on dangerous impacts and cooresponding adaptation needs. He also informed that the Millenium Ecosystem Assessment (MA) focused on population growth in last 50 years. From MA Synthesis: "Between 1960 and 2000, the demand for ecosystem services grew significantly as world population doubled to 6 billion people." Prof Li illustrated recent growth but in the context of the longer term trends. He quoted from Population Reference Bureau that "World population expanded to about 300 million by A.D. 1 and continued to grow at a moderate rate. But after the start of the Industrial Revolution in the 18th century, living standards rose and widespread famines and epidemics diminished in some regions. Population growth accelerated. The population climbed to about 760 million in 1750 and reached 1 billion around 1800" He informed that the world population was 1 billion in the year 1804, 2 billion in 1927 (it took 123 years to double), 4 billion in 1974 (it took 54 yrs to double); 6.5 billion in July 2005. In the last 45 years (since 1960) more people have been added to the planet (3.4 billion) than lived on the planet in 1960.

Referring to MA Synthesis and a figure showing the extent of Cultivated Systems in the year 2000, Prof. Li informed that the cultivated systems cover 24% of the terrestrial surface. The structure and functioning of the world's ecosystems changed more rapidly in the second half of the twentieth century than at any time in human history. More land and was converted to cropland in the 30 years after 1950 than in the 150 years between 1700 and 1850. Cultivated systems (areas where at least 30% of the landscape is in croplands, shifting cultivation, confined livestock production, or freshwater aquaculture) now cover one quarter of Earth's terrestrial surface, he added. Discussing conversion of terrestrial biomes, Prof. Li mentioned that it is not possible to estimate accurately the extent of different biomes prior to significant human impact, but it is possible to determine the "potential" area of biomes based on soil and climatic conditions. He quoted from MA that "Humans are fundamentally, and to a significant extent irreversibly, changing the diversity

of life on Earth, and most of these changes represent a loss of biodiversity. More than two thirds of the area of two of the world's 14 major terrestrial biomes and more than half of the area of four other biomes had been converted by 1990, primarily to agriculture." MA also quotes that "Climate change in the past century has already had a measurable impact on ecosystems". Earth's climate system has changed since the preindustrial era, in part due to human activities, and it is projected to continue to change throughout the twenty-first century. During the last 100 years, the global mean surface temperature has increased by about 0.6 degree Celsius, precipitation patterns have changed spatially and temporally, and global average sea level rose by 0.1–0.2 meters. Observed changes in climate, especially warmer regional temperatures, have already affected biological systems in many parts of the world. There have been changes in species distributions, population sizes, and the timing of reproduction or migration events, as well as an increase in the frequency of pest and disease outbreaks, especially in forested systems. The growing season in Europe has lengthened over the last 30 years. Although it is not possible to determine whether the extreme temperatures were a result of human-induced climate change, many coral reefs have undergone major, although often partially reversible, bleaching episodes when sea surface temperatures have increased during one month by 0.5–1 degree Celsius above the average of the hottest months. Extensive coral mortality has occurred with observed local increases in temperature of 3 degree Celsius. He also informed that 4 of 5 warmest years since 2000; 19 of the 20 warmest since 1980 is an alarming evidence of warming. Prof. Li summarised main findings from AR4 on the impacts side as follows:

- Many natural systems are being affected by regional climate changes, particularly temperature increases.
- Anthropogenic warming has had a discernible influence on many physical and biological systems.
- Magnitudes of impact can now be estimated more systematically
- Impacts due to altered frequencies and intensities of extreme weather, climate and sea-level events are very likely to change.
- Some large-scale climate events have the potential to cause very large impacts, especially after the 21st century.
- Impacts of climate change will vary regionally but, aggregated and discounted to the present, they are very likely to impose net annual costs which will increase over time as global temperatures increase.

Prof. Li further added that for the next two decades a warming of about 0.2 degree Centigrade per decade is projected for a range of SRES emission scenarios. Anthropogenic warming and sea level rise would continue for centuries due to the timescales associated with climate processes and feedbacks, even if greenhouse gas concentrations were to be stabilized. Temperatures in excess of 1.9 to 4.6 degree Centigrade

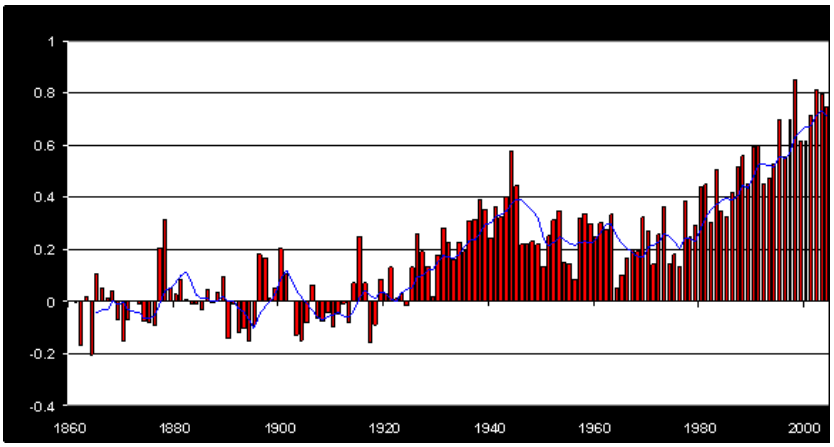

Figure 13: Global Surface Temperature (o C) relative to 1890-1900 mean

(from 1.1 to 6.4 degree Centigrade) warmer than pre-industrial era sustained for millennia will lead to eventual melt of the Greenland ice sheet and will raise sea level by 7 m, comparable to 125,000 years ago. He summarised current knowledge about future impacts as follows:

WATER: Water supplies stored in glaciers and snow cover are projected to decline, reducing water availability in regions supplied by melt water from major mountain ranges, where more than one-sixth of the world population currently lives.

ECOSYSTEMS: ~20-30% of plant and animal species assessed so far are likely to beat increased risk of extinction if increases in global average temperature exceed1.5-2.5°C

FOOD: At lower latitudes, crop productivity is projected to decrease for even small local temperature increases(1-2°C). At higher latitudes crop productivity is projected to increase for temperature increases of 1-3°C, then decrease beyond that.

COASTS: Many millions more people are projected to be flooded every year due to sea-level rise by the 2080s.

INDUSTRY, Settlement and Society: The most vulnerable industries, settlements and societies are generally those in coastal and river flood plains, those whose economies are closely linked with climate sensitive resources, and those in areas prone to extreme weather events, especially where rapid urbanization is occurring.

HUMAN HEALTH: Projected climate change-related exposures are likely to affect the health status of millions of people, particularly those with low adaptive capacity.

Prof. Li referred to multi model averages and assessed ranges for surface warming and informed that many natural systems are being affected by regional climate changes, particularly temperature. Effects of regional increases in temperature on some managed and human systems are emerging. Climate change is affecting natural and human

systems in regions of snow, ice and frozen ground hydrology and water resources, coastal zones and oceans. Both terrestrial and marine biological systems are now being strongly influenced by observed recent warming. The internal variability of climate system will offset the anthropogenic global warming signal for next few years. Climate will continue warming, with at least half of the years after 2009 predicted to exceed the warmest year-1998 (Science, August 2007).

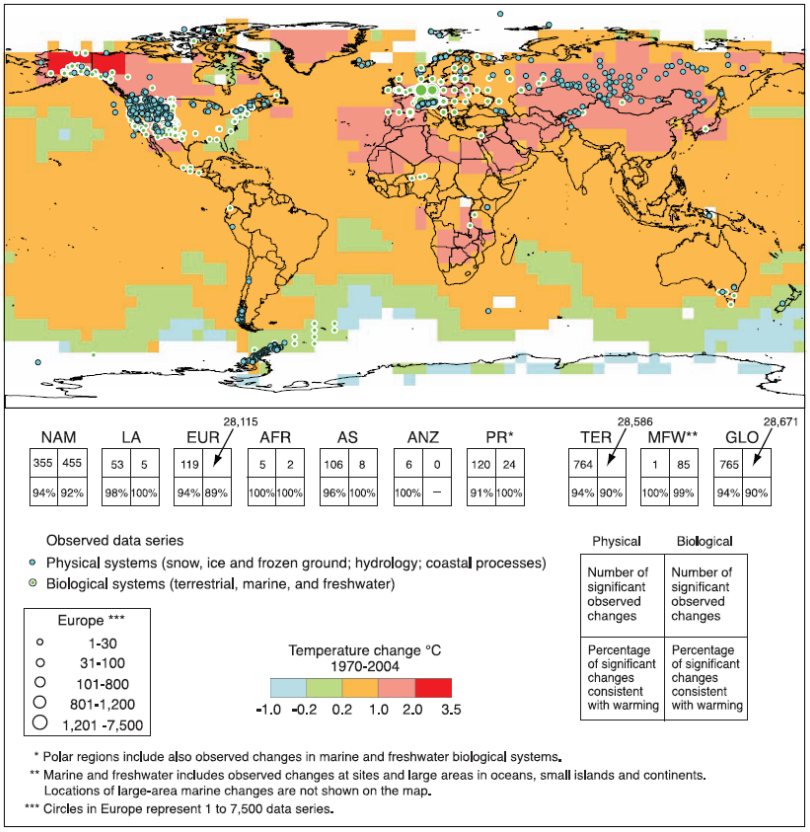

Figure 14: Locations of significant changes in data series of physical systems (snow, ice and frozen ground; hydrology; and coastal processes) and biological systems (terrestrial, marine and freshwater biological systems), are shown together with surface air temperature changes over the period 1970-2004.

Prof. Li listed some systems, sectors and regions which are likely to be especially affected:

1. Some terrestrial ecosystems,: tundra, boreal forest, mountain, mediterranean-type ecosystems;

2. Along coasts: mangroves and salt marshes;

3. In oceans: coral reefs and the sea ice biome.

4. Low-lying coastal regions due to the threat of sea-level rise and increased occurrence of extreme weather events.

5. Water resources in mid-latitudes and the dry tropics due to decreases in rainfall and higher rates of evapotranspiration.

6. Agriculture in low-latitude regions are due to reduced water availability.

7. Human health in areas with low adaptive capacity.

8. Small islands, due to high exposure of population and infrastructure to sea-level rise and increased storm surge.

9. Asian mega-deltas due to large populations and high exposure to sea-level rise, storm surge and river flooding.

10. Africa, small islands, the Arctic. Changes in rainfall pattern are likely to lead to severe water shortages and/or flooding. Melting of glaciers can cause flooding and soil erosion.

Prof. Li presented key findings of AR4 in the adaptation side as follows:

1. Some adaptation is occurring now, but on a limited basis.

2. Adaptation will be necessary to address impacts

3. More extensive adaptation is required to reduce vulnerability to future climate change. There are barriers, limits and costs, but these are not fully understood.

4. Vulnerability to climate change can be exacerbated by the presence of other stresses.

5. Future vulnerability depends not only on climate change but also on development pathway.

6. Sustainable development can reduce vulnerability to climate change, and climate change could impede nations' abilities to achieve sustainable development pathways.

7. Many impacts can be avoided, reduced or delayed by mitigation.

8. A portfolio of adaptation and mitigation measures can diminish the risks associated with climate Change.

Talking about climate change and human life, Prof. Li informed that climate change will have wide-ranging effects on the environment, and on socio-economic and related sectors, including water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity and coastal zones. Changes in rainfall pattern are likely to lead to severe water shortages and/or flooding. Melting of glaciers can cause flooding and soil erosion. Rising temperatures will cause shifts in crop growing seasons which affects food security and changes in the distribution of disease vectors putting more people at risk from diseases such as malaria and dengue fever. A rise in extreme events will have effects on health and lives as well as associated environmental and economic impacts.

Prof. Li opined that there is a very urgent need for adaptation. There are many options and opportunities to adapt. These range from technological options such as increased sea defenses or flood-proof houses on stilts, to behaviour change at the individual level, such as reducing water use in times of drought and using insecticide-sprayed mosquito nets. Other strategies include early warning systems for extreme events, better water management, improved risk management, various insurance options and biodiversity conservation. Because of the speed at which change is happening due to global temperature rise, it is urgent that the vulnerability of developing countries to climate change is reduced and their capacity to adapt is increased and national adaptation plans are implemented. Future vulnerability depends not only on climate change but also on the type of development path that is pursued. Thus adaptation should be implemented in the context of national and global sustainable development efforts. The international community is identifying resources, tools and approaches to support this effort.

In the second part of his presentation, Prof. Li mentioned about regional impacts, adaptation and vulnerability in Asia as follows:

- A 1 m rise in sea level would lead to a loss of almost half of the mangrove area in the Mekong River delta (2,500 km^2), while approximately 100,000 ha of cultivated land and aquaculture area would become salt marsh.

- Coastal areas, especially heavily populated megadelta regions in South, East and South-East Asia, will be at greatest risk due to increased flooding from the sea and, in some megadeltas, flooding from the rivers. For a 1 m rise in sea level, 5,000 km^2 of Red River delta, and 15,000 to 20,000 km^2 of Mekong River delta are projected to be flooded, which could affect 4 million and 3.5 to 5 million people, respectively.

- Tibetan Plateau glaciers of under 4 km in length are projected to disappear with a temperature increase of 3°C and no change in precipitation.

- If current warming rates arema intained, Himalayan glaciers could decay at very rapid rates, shrinking fromt he present 500,000 km^2 to 100,000 km^2 by the 2030s.

- Around 30% of Asian coral reefs are expected to be lost in the next 30 years, compared with 18% globally under the IS92a emissions scenario, but this is due to multiple stresses and not to climate change alone.

- It is estimated that under the full range of SRES scenarios, 120 million to 1.2 billion and 185 to 981 million people will experience increased water stress by the 2020s and the 2050s, respectively.

- The per capita availability of freshwater in India is expected to drop froma round 1,900m3currently to 1,000m3 by 2025 in response to the combined effects of population growth and climate

change [10.4.2.3]. More intense rain and more frequent flash floods during the monsoon would result in a higher proportion of runoff and a reduction in the proportion reaching the groundwater.

- It is projected that crop yields could increase up to 20% in East and South-East Asia, while they could decrease up to 30% in Central and South Asia by the mid-21st century. Taken together and considering the influence of rapid population growth and urbanisation, the risk of hunger is projected to remain very high in several developing countries. * N [10.4.1]

- Agricultural irrigation demand in arid and semi-arid regions of East Asia is expected to increase by 10% for an increase in temperature of 1°C.

- The frequency and extent of forest fires in northern Asia are expected to increase in the future due to climate change and extreme weather events that would likely limit forest expansion.

Prof. Li summarized priority adaptation projects identified by National Adaptation Programmes of Action (NAPA's) as follows:

- Improved forecasting for farming, extreme events and disaster management;

- Improved water management for drinking and agriculture through understanding water flows and water quality, improved rainwater harvesting and water storage and diversification of irrigation techniques;

- Improved food security through crop diversification, developing and introducing drought, flood and saline tolerant crops, improving livestock and fisheries breeding and farming techniques, developing local food banks for people and livestock, and improving local food preservation;

- better land and land use management through erosion control and soil conservation measures, agroforestry and forestry techniques, forest fire management and finding alternative energy sources to wood and charcoal, as well as better town planning;

- coastal zone management including coral monitoring and restoration and improving coastal defences through afforestation, reforestation, set-back areas and vegetation buffers;

- improved health care through flood shelters and assistance shelters as part of community emergency preparedness programmes, better health education, better access to primary health care such as distribution of treated mosquito nets and better malaria surveillance programmes and habitat clearance;

- capacity-building to integrate climate change into sectoral development plans, involving local communities in adaptation activities, raising public awareness and education on climate change, and enabling representation at international meetings;

- Promotion of sustainable tourism.

In the final part of his lecture, Prof. Li talked about global warming and its impacts in China. China's preliminary results show the temperature increase to be between 0.5~0.8 °C, however the impacts of climate change were different and severe. Till 2100 in China - precipitation days is likely to increase in northern part; heavy precipitation days is likely to increase in southern part; local heavy precipitation events are likely to increase and Sea level is likely to continue to rise. As a result, public awareness as well as published research about climate change in China has increased substantially.

Four-thousand years ago, the forest coverage in China was up to 60%, but by the end of 20th century was only 17%, equivalent to 61% of the world average. Similarly, the rate of grassland degradation also accelerated in China. Economical losses due to meteorological disasters continue to increase in China. In January 2008, snow disaster seriously damaged tree and biodiversity in Southern China.

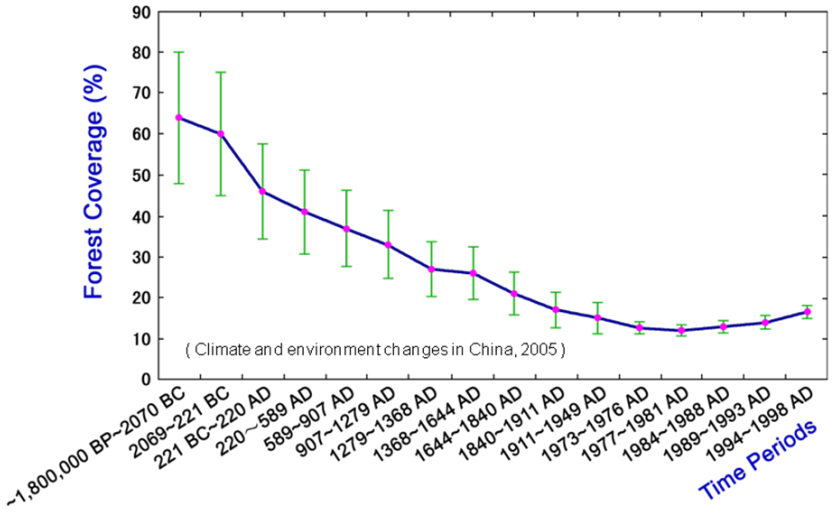

Figure 15: Forest Cover in China

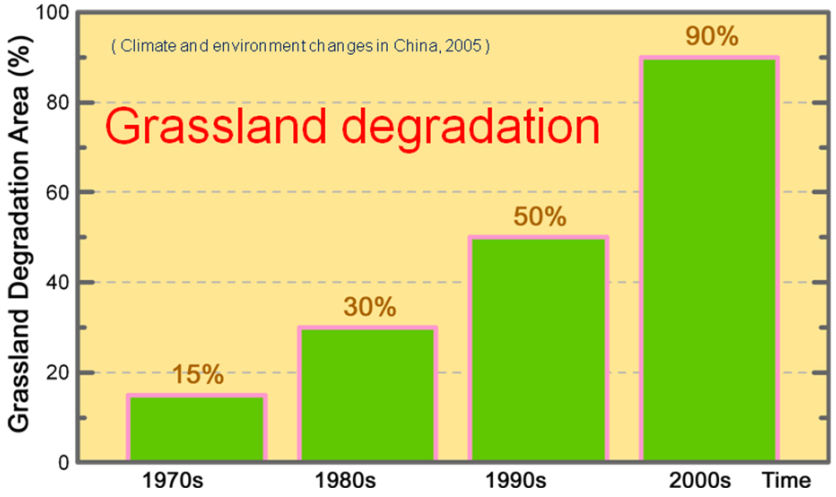

Figure 16: Grassland degradation

Highlighting the impact of climate change on agriculture, Prof. Li mentioned that crop damage from spring frost has increased due to mild winters that lead to earlier onset of budding and flowering in winter wheat, trees and fruit, making them more vulnerable to cold. Winter wheat plantation in northeast China moved northward and extended westward. Certain varieties of maize that have a relatively long growth period and high yield have been grown more widely, resulting in increased output. Socio-economic scenarios for China reveals that population might begin to decline from the year 2040. However per capita energy consumption and GDP will continue to rise. Different regions in China will experience varying levels of vulnerability. By 2030, the sea levels along Chinese coastal areas could rise by 0.01~0.16m, increasing the possibility of flooding and intensified storm surges. It Could exacerbate the instability of water resources distribution and the gap between water demand and supply. According to IPCC, globally, the potential for food production is projected to increase with increases in local average temperature over a range of 1-3 °C, but above this it is projected to decrease. However in China, by 2030, the overall crop productivity can decrease 5~10% if no action is taken. By the second half of the 21st century, climate change can cause yield reduction in rice, maize and wheat up to 37%. In the next 20~50 years, agricultural production may be seriously affected, compromising long-term food security in China. Priority area setting for biodiversity conservation under climate change in China is as follows:

- Basic database : digitized 1:1 million vegetation map, 1:250 thousand electronic maps including topography, political boundaries, road system and settlements.
- Focal species : Mapping potential habitats now and climate change scenario of 216 focal species based on species-habitat model: Mammal species 59, Bird species 51, Plant species 106.
- Ecosystem: 145 priority ecosystem types distribution and potential movement under climate change scenario

- All habitat of focal species and distribution of priority ecosystem now and under climate change were regarded as conservation targets

- SCP uses CPLAN as a tool to calculate the Irreplaceability of planning units for identifying conservation priority areas

Climate change impacts inn China were summarised by Prof. Li as follows:

Impacts of climate change on different regions of China will be as follows:

Warming	1~2°C (2020)	2~3°C (2050)	3~5°C (2080)
water	All regions balance	N China: -2% NW China: -3%; others: balance	N China: -1% NW China: -4%; others: balance;
Agriculture	additional water requirement; Cold disaster alleviated in NE China	Crop yield decrease 5~10%,variation among regions and crops ;550 ppm CO_2 increases C3 crop yield 17%;Adaptation increases all crops above baseline yield	CO_2 fertilization effect of 560~720 ppm will set off a decrease of crops production due to the warming climate in 3.2~3.8°C,
Ecosystem service	NE: Reduction of suitable woodland, -9%~2 %; NW & W TP: upgrading eco-frangibility	fir and pine 2.75°~6 °northward; defoliated pine reduced the south limit reach 51°N	Definitely expansion of areas with light to medium serious eco-frangibility
Coastal zone management	Cost/effectiveness for dyke building : 0.081~0.1% of GDP	Suppose 30cm sea level rise will happen, the cost for additional dyke building : 0.034~0.04% of GDP	Suppose 65cm sea level rise will happen, cost for dyke building :0.008~0.028% of GDP

NE.CHINA: wetland and permafrost would deteriorate or disappear

N.CHINA: water demand would increase significantly, water shortage would get worse

NW.CHINA: water shortage could reach about 20 billion m3 /a between 2010~2030

E.CHINA: the 1/100 frequency of flood occurrence in one hundred years would increase

C.CHINA: would decrease the yield of double-harvest rice

SW.CHINA: the strength, scale, scope and frequency of land disasters are expected to increase over time resulting in more severe losts.

S.CHINA: Sea level rise, estimated to be between 0.60 m~0.74 m by 2100, mangrove areas would move northward and the scope of coral bleaching would expand

Prof. Li also shared that in China, the State Council approved (on 3rd June 2009) the China National Programme to Combat Climate Change, formulated by National Development and Reform Commission in cooperation with other relevant sectors. The Programme is divided into five parts, the main contents of which are as follows:

- Status and Climate Change Adaptation Efforts
- China National Conditions and Impacts of Climate Change
- Principles and Objectives of Climate Change Adaptation in China
- Policies and Measures
- Basic Standpoint and International Cooperation Demands

Within the national program, China's efforts and achievements in mitigating climate change are:

- First, adjusted structure and improved energy efficiency.
- Second, optimizing energy mix by developing low-carbon and renewable energy.
- Third, launching nation-wide tree-planting and afforestation campaign and enhancing ecology restoration and conservation.
- Fourth, effectively controlling growth rate of population through family planning.

The program also recognize that the climate conditions of China are relatively poor with more severe natural disasters. China is a country with a relatively vulnerable ecological environment. Most grassland represents alpine grassland and desert grassland. The temperate grassland in Northern China faces crisis of degradation and desertification. Right now the area suffered from desertification in China accounts for 27.4% of national territory. The length of Chinese coastal line is of 18,000 km with its neighboring natural maritime space of 4.73 million km^2. The number of islands with area of over 500 m^2 each amounts to over 6500, so, sea level rising may bring negative impacts on these islands. Being constrained by endowment of resources China relies mainly on coal for its primary energy needs. In 2005, coal consumption accounts

for 68.9% of total primary energy sources, but only 27.8% if compared globally . China is the world's most populous country and the level of economic development is still low. The impacts of climate change on China are embodied in agriculture, forest and other ecosystems, water resources, coastal zone environment and ecosystems etc. China advocates for following six principles for climate change adaptation:

- To combat climate change within framework of sustainable development;
- To insist principle of "Common but Different Responsibility"
- Equal emphasis on mitigation and adaptation;
- Harmonious combination of policy related to combat climate change with other relevant policies;
- To rely on progress and innovation in science and technology;
- Principle of active participation and broad cooperation.

Objectives of climate change adaptation in China includes

Controlling greenhouse gas emission:

Towards this, various initiatives listed are: to cut energy intensity per unit of GDP by around 20 percent from the 2005 level, thus to appropriately mitigate emission of carbon dioxide; to make maximum efforts to increase the share of renewable energy in primary energy supplies to about 10 percent (including huge hydropower stations); to achieve a target of 10 billion m^3 of coal bed methane; to make maximum efforts to keep emission level of nitrous oxide stable at the level of 2005; to promote agricultural extension of new techniques, strengthen measures of utilisation of biogas and control increase rate of methane emission; and to make great efforts to increase forest cover up to 20%.

Enhance capacity of adapting to climate change:

To add 24 million ha of improved grassland, treat 52 million ha of degraded, sandified and alkalinized grassland, raise coefficient of effective utilisation of water used for agriculture irrigation to 0.5; To realise conservation of approximately 90% of typical forest ecosystem and key wildlife and plant species listed as the target under national protection, increase the share of nature reserves to about 16 % of China's total landmass, and treat 22 million ha of desertified land; to build up major flood control system of great rivers and raise drought resistant standard of farmland; to enhance capacity of coastal area to combat marine disasters, thus to diminish impact of sea level rising on society and reduce economic loss.

Overall strategy of China aims at integrated approach. According to requirement of implementing the outlook on scientific development it is necessary to combine adaptation to climate change, sustainable development strategy, development of a conservation-minded and environmental friendly society, and making China an innovative country with an aim at mainstreaming to a master plan of national economic and social development. Efforts should be made to mitigate green house gas emission from one hand, and at the meantime to enhance adaptation capacity to climate change from another hand. Government of China shall take all measures including laws, economic, administrative and technical approaches to save energy, optimize energy structure, improve eco-environment, enhance adaptation capacity, strengthen science and technology potential and research, improve public awareness on climate change and perfect management mechanism of climate change, and in this way to achieve the objectives and tasks specified in China's National Climate Change Programme. To curb GHG emissions, China's policy is :

- It is estimated that emission of some 500 million tons of carbon dioxide can be reduced by 2010 through speedy development of hydropower generation in the field of energy production and conversion;

- It is estimated that emission of some 50 million tons of carbon dioxide can be reduced through active development of nuclear power generation;

- Energy saving and reform of electricity dispatching. Priority is given to generation of clear energy by wind, solar, ocean, water, biomass, nuclear etc. Regarding thermal power generating units, the electricity dispatching will be performed based on coal consumption level. It is estimated that since 2010 annual saving of raw coal can amount to 90 million tons with reduced emission of carbon dioxide 216 million tons;

- Emission of some 110 million tons of carbon dioxide can be reduced by 2010 through speeded technical progress and elimination of small and out-of-date thermal power generation units;

- Encourage to perform cooperative CDM projects to use coal mine gas through powerful development of coal-bed methane industry. Thus, it is estimated that emission of some 200 million tons of greenhouse gas (carbon dioxide equivalent) can be reduced by 2010.

- It is estimated that emission of 30 million tons of greenhouse gas (carbon dioxide equivalent) can be reduced by 2010 through development of biomass energy, and 60 million tons of carbon dioxide through actively supported development of wind, solar, geothermal and ocean energy;

- To increase 50 million tons of carbon dioxide sink compared to that in 2005 through strengthened forestry carbon sink;

- It is estimated that during 11th Five Year Planning some 240 million tce can be saved, equaling reduced emission of 550 million tons carbon dioxide through implementation of five key energy saving programmes. During 11th Five Year Planning some appropriate administrative countermeasures have been undertaken in the fields of industrial production process, agriculture, forestry and management of urban wastes in order to control emission of greenhouse gas under framework of sustainable development.

- In the fields of agriculture: agricultural infrastructure shall be continuously strengthened, agricultural structure and planting system shall be adjusted with selection of high resistibility crop species. Take measures to halt increased desertification of grassland and strengthen research and development of new technology;

- In the fields of forest and other nature eco-systems: It is necessary to formulate and implement laws/regulations related to adaptation to climate change, strengthen effective conservation of existing forest resources and other natural eco-systems, promote forestry extension and application, reduce adverse impact of climate change on biodiversity and improve early warning capacity and emergency power;

- In the fields of water resources: It is planned to create system of water conservancy investment and financing and system of water conservancy management adapted to market economic mechanism. It is necessary to strengthen planning and development of infrastructure, appropriately manage large water resources allocation, undertake research & development and extension of water saving technology as well as seawater utilisation. It is also necessary to formulate and perfect relevant laws and regulations in coastal zone and coastal area, strengthen technical development and extension and enhance monitoring and early warning capacity of marine environment.

- Chinese government decides to establish the National Leading Group to Address Climate Change with Premier Wen Jiabao as a leader of the group. The government of China shall also take a set of active measures and policies to continuously strengthen comprehensive adaptability to climate change in the fields of science and technology, public awareness, institutional structure and mechanism related to climate change.

Basic Standpoint of China on problems related to climate change

1. Mitigation of emission of greenhouse gas: China, being a developing country, shall make efforts to control emission of greenhouse gas and make its contribution to mitigating climate change by improved energy efficiency, saving resources, developing renewable energy, strengthened ecological conservation and development, and launching tree planting campaign, based on sustainable development strategy.

2. adaptation to climate change: Adaptation to climate change is an indispensable part of countermeasures to combat climate change. In the past no sufficient attention was paid to adaptation. China is willing to have cooperation with international community and participate in international activities and formulation of legal instruments in the fields of adaptation.

3. technical cooperation and technology transfer: It is necessary to establish an effective cooperation mechanism in favour of research, development, application and transfer of technology. It is also necessary to eliminate obstacles of technical cooperation existing in the fields of policy, system, procedures, finance and intellectual property rghts protection, thus to provide incentives to technical cooperation and transfer in favour of successful implementation of above-mentioned technical cooperation and transfer. It is necessary to establish an international cooperation fund to make developing countries affordable to buy and use advanced and environmentally friendly technology.

4. implement obligations of UNFCCC and Kyoto Protocol: China as a responsible country shall honestly implement its obligations under UNFCCC and the Protocol.

5. regional cooperation of climate change: Any regional cooperation represents a useful supplementation to CBD and the Protocol, rather than replacement with an aim to fully mobilise enthusiasm of all sectors to address climate change and promote practical international cooperation. China shall participate in regional cooperation of climate change based on this spirit.

International cooperation demands of China in climate change are as follows:

TECHNICAL TRANSFER AND COOPERATION DEMANDS: The main technical requirements in the fields of reduction of greenhouse emission includes advanced energy technique and manufacture technique, environment and resources integration technique, high efficiency transportation technique, new material technique and new type building material technique etc. The main technical requirements in the fields of adaptation to climate change includes high efficiency water saving agricultural, saving and recycling use technique of industrial water resources, treatment technology of industrial and domestic wastewater, water saving technique of domestic water, high efficiency technique of flood control, agricultural bio-technique, agricultural breeding technique, technique of new type fertilizers and disease and pest control for crops, disease and pest control technique for forestry and grassland, technology of fast growing forest and high efficiency fuel forest, technology of rehabilitation and restoration of ecological system for wetlands, mangrove and coral reefs, and observation and early warning technique for floods, drought, sea level rising and agricultural disasters etc.

Capacity building demands:

IN TERMS OF HUMAN RESOURCES DEVELOPMENT: Main requirement includes basic research on climate change, analysis on policy regarding mitigation and adaptation, information system development, as well as capacity building such as personal training for management of clean development mechanism projects, international exchange, discipline development and professional skills development etc.

IN TERMS OF ADAPTATION TO CLIMATE CHANGE: Main requirement includes development of projects related to adaptation to climate change, case study on extreme climate events, perfection of climate observation, capacity building of sectors for water resources and agriculture in coastal area in the field of adaptation to climate change;

IN TERMS OF TECHNICAL TRANSFER AND COOPERATION: Main requirement includes timely tracking development trend of international technology, effective identification and evaluation of advanced but appropriate technique in the field of climate change, analysis on countermeasure on promotion of technical transfer and cooperation and improved absorption of transferred technique;

IN TERMS OF RAISED PUBLIC AWARENESS: Main requirement includes formulation of long/middle term planning and related policy on public awareness on climate change and establishment of professional publicity network and institution capable of connecting international community; training of publicity and communication talents, various publicity activities towards to different regions and multi-stakeholders, popularisation of knowledge about climate change and leading and encouraging public to select consumption models in favour of climate change; (cited from "A Circular on Nation-wide Action for Energy Conservation and Pollutant Discharge Reduction" released by NDRC on 28 August 2007 with reference No. [2007]2132)

IN TERMS OF INFORMATION SYSTEM DEVELOPMENT: Main requirement includes distributed database groups of climate change information, climate change information sharing platform, based on net, and application-oriented climate change system and information service system, public service system and industrial development information service system, international information exchange and cooperation, all these are considered as capacity building;

Finally, Prof. Li summarised challenges on adaptation as : Lack of high level political involvement; need a national strategy for adaptation; need to develop guidance on adaptation, drawing initially on academic research, experiences and the action of 'learning by doing' ; funding is unrealistically low; need a policy to encourage enterprises to input more to adaptation, so that funding become pluralistic. He recommended that : Raise awareness of adaptation within high levels; establish a coordination committee/ multidisciplinary group on adaptation; integrate

climate impacts into development planning; increase demand driven research with user friendly outputs; and increase regional cooperation on adaptation, including for technology transfer.

MAINSTREAMING ADAPTATION TO DEVELOPMENT PLANNING

Prof. Nobuo Mimura, Director, ICAS. Professor, Center for Water Environment Studies Vice President Extraordinary, Ibaraki University

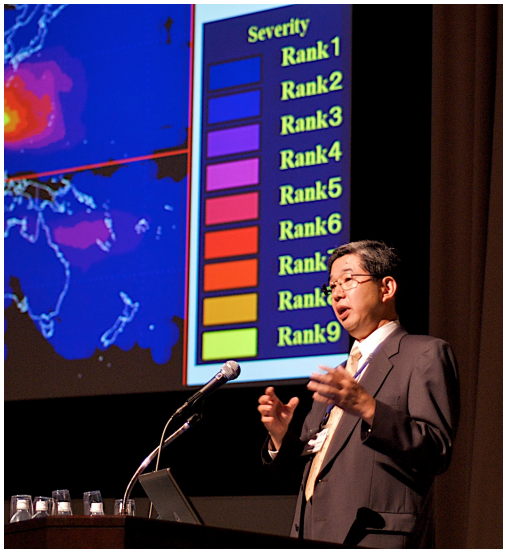

Figure 17: Prof. Nobuo Mimura

Impacts of Climate Change in Asia, the Pacific and Africa were discussed by Prof. Mimura briefly in the first part of his key note lecture. Towards addressing questions like - how to respond to this issue, what is the best way, he advocated for adaptation and while giving thrust on role of scientific research and higher education in this endeavor. He mentioned that climate change variability and extreme events are two major elements which will impact water resources, water cycle, ecosystem, coasts and oceans, agriculture and food supply, human life, energy, industry, insurance and finance etc. He informed that the arctic, Sub-Saharan Region of Africa, small islands and Asian megadeltas are the four most vulnerable areas identified by IPCC's AR4. He further added that developing countries with less adaptive capacity are most vulnerable and furthermore, in these countries, poor and the disadvantaged people are especially vulnerable to the adverse impacts of climate change. He shared that the world population is growing at 77 million per year with two-third of the growth happening is Asia and the Pacific. Additionally, most megacities in the world are housed in Asia. Present ten megacities in Asia will increase to 25 by the year 2025 which essentially means more people will move from inland to the coast bringing more population concentration.

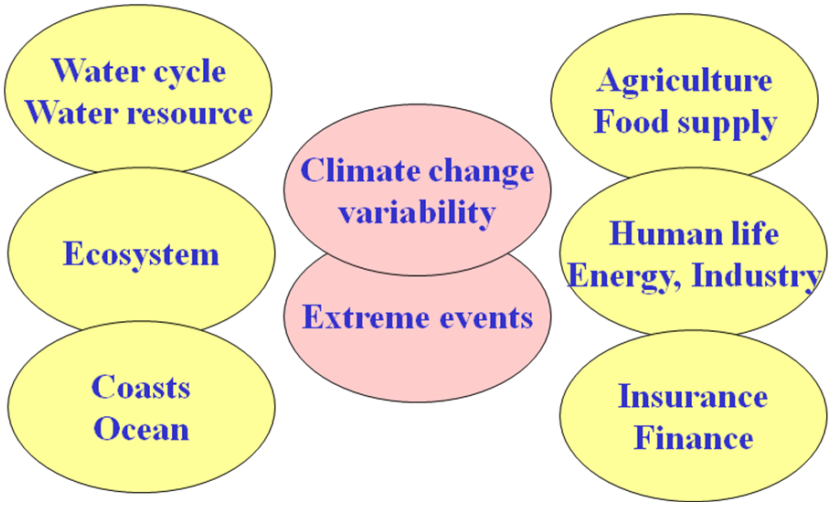

Figure 18: Major climatic elements affecting Nature and Human activities relation

Prof. Mimura discussed about hot spots of typhoon and informed that northern part of Philippines is the severe most hotspot which spreads towards Southern China and Japan. Another similar hotspot is coastal area bordering Indiana and Bangladesh. He further elaborated natural disaster trends in Asia and highlighted that especially hydro-meterological disasters are increasing in this region. For example, number of tropical cyclones hitting vietnam coast during 1961-2008 fluctuates however increasing trend in appearing. Northern vietnam is experiencing very serious erosion of coastline and with sea level rise and increased wave-energy, erosion will increase further. Other regional experiences include the mangroves in Thailand (Chaophraya River) where erosion has been a serious problem after the retreatment of the mangroves. This is in fact not solely caused by climate change. Increasing numbers of construction works along the river and a natural process of relative sea level rise are also other contributing factors. In Bangladesh, several hundreds of people were killed by a number of cyclones in the past, yet recently, the number has been decreasing thanks to the countermeasures taken; development of warning system as well as creating evacuation place and routes. In small islands in the Pacific area such as Funafuti in Tuvalu where runways of the lagoon is only 50 cm above the sea level, appropriate modern technology and natural protection strategies have been taken in addition to the community maintenance, which shows an example of the combination of traditional and today's wisdoms. He further commented on the situation in Africa where people have different ranges of vulnerability.

In the second part of his speech, Prof. Mimura discussed adaptation to address climate change. Among the possible two responses to the issue – mitigation and adaptation – he emphasized that to obtain a portfolio of both strategies is the only way to address risks although a ratio of the stress may vary from country to country. He pointed out five key issues on adaptation. (1) Mainstreaming adaptation is to take into account future climate change risks in the development planning which creates

win-win situation for both present and future generations. (2) Another mainstreaming adaptation is to be a comprehensive approach with a prudent consideration on other aspects of sustainable development such as water resource development, disaster prevention, poverty reduction, and so on. (3) Acknowledging that today's world is faced with a wide variety of problems, adaptation to climate change can also offer safer and healthier bases for the future development. (4) As for the funding for adaptation, planning of the overseas development assistance (ODA) should incorporate present and future conditions. He also noted that the present framework for adaptation funding is unfortunately quite insufficient to fulfill today's requirement which ranges from 4 billion to 100 billion US dollers. (5) Adaptive capacity for adaptation should be rooted in every local community in each country. Additionally he stressed the importance of the reviewing process of adaptation once in every 5 to 10 years according to the development of the scientific knowledge. Thus mitigation and adaptation strategies he thinks are the re-building practice.

Prof. Mimura finally concluded his speech by stating a role of scientific research and higher education. If we consider climate change for instance, its role can be to fulfill the needs to build capacity to deal with each step of the issue by observing, monitoring, predicting, and assessing impacts. He said that considering climate change is consisted of two processes at various levels (from a process to understand the scientific system to a process to formulate policies and implement them), universities should serve to fulfill such responsibility. Therefore he sees the proposal of the higher education of the climate change adaptation brought by this conference as quite timely and essential.

SUSTAINABILITY SCIENCE FOR ACTION

Prof. Hiroyuki Yoshikawa, Director-General, The Center for Research and Development Strategy (CRDS), Japan Science and Technology Agency (JST)

Figure 19: Prof. Hiroyuki Yoshikawa

Dr. Yoshikawa began his speech by explaining how adaptation, a term used in a theory of evolution, can be applied to the context of the human evolution and divided into two kinds: social and physical. Social adaptation refers to the changes of traits, for instance changing the style of consumption, of utilizing the natural ecosystem, and so on. Physical adaptation, on the other hand, refers to a change of habitat such as the change of scientific technology by developing a disaster mitigation and artificial ecosystem, inverting the technology of manufacturing, and so on. He pointed out that the latter, the physical adaptation, should be a matter of concern in today's sustainability science, that is to say, to consider the ways to change is more important than to consider which technology to be used or not. The science for sustainability will be a key for us to get along with a process of the evolution of human being. He admits that it is impossible to change existing knowledge as it is our heritage, but that it is possible and is necessary to add to it. To answer a question whether to enrich our knowledge in science or to bring the existing knowledge into a different stage will make a significant difference in approaching sustainability.

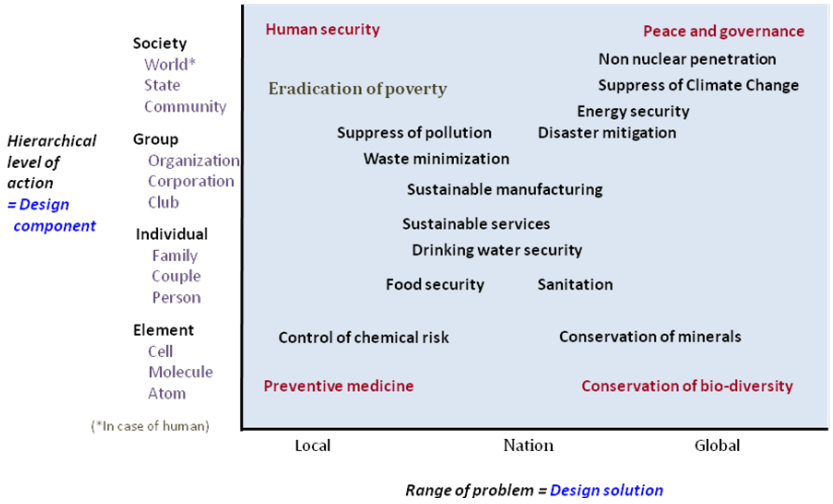

Figure 20: Diversified Elements of Sustainability (Design components and solutions)

The engineering discipline of sustainability is neither an application of existing sciences nor a mix of existing engineering disciplines. This is because, first of all, the problems of sustainability we face today vary from local, national, and global levels and the actions required also vary from societal, individual, to elemental (molecular) levels. In order to realize sustainability and to solve problems such as climate change, we need to pay more careful attention to various aspects from human security, peace and governance, to biodiversity conservation. Since a new domain of engineering requires knowledge not easily found in traditional science discipline, it is necessary to create a new kind of knowledge and a set of new domain, which he calls sustainability science.

To highlight what is required for the sustainability based on the sustainability science, Dr. Yoshikawa showed differences between traditional science (partly today's science) and sustainability science by comparing aims, objects, observations, truth verifications, result of researches, and expected practical results of each. Firstly, when we consider a technology or knowledge in need in society, we will find that the aims of technology development have been changing from time to time. For example, in the past, human beings had gained knowledge and developed technologies for survival and to protect themselves from the evils from the outside of the human society. In contrast, since the industrial revolution until recently, we had pursued knowledge to gain comfort and wellbeing in our lives. However now, we have been faced with new kinds of terrors and we again have to seek science for survival.

While explaining elements of sustainability through diversified categories of design, Prof. Yoshikawa presented a table below:

Elements (examples)	Design solution	Design compo-nent	Actors	Method/knowledge
Peace and governance	Global	State	Nation(UN)	Politics, economy, technology
Bio-diversity	Global	Atom	Scientist, farmer, forester	Sciences (natural, social)
Preventive medicine	Local (person)	Atom	Medical doctor	Medical science
Human security	Local (person)	State	Nation(UN)	Politics
Poverty eradication	Local (family)	State	Govement	Society, education
Sustainable manufacturing	Nation	Organi-zation	Scientist, engineers, industrialists	Science, technology

Dr. Yoshikawa said that the different motivations of creating and approaching knowledge are due to the different roots of study. Historically, the disciplines in science were made to fight with external evil, which can be observed from the diversified departments at the university. For instance some universities have many engineering faculties in the department of science, depending on what kind of engineering to deal with. (i.e., Civil engineering, mechanical engineering, electrical engineering, etc). Such sub-division of discipline has been passed on to serve the interest of division of labor in practice and has created groups of professionals who do their best only in their specialty and tend to prefer separating their jobs from other groups of professionals. He maintains that the sub-division by nature is not necessarily a problem, but that one of the defective elements is that they lack in communication between the fields.

This can be a serious problem when it comes to facing with today's evils such as population explosion, extreme poverty, and climate change, which cannot be solved by using the existing knowledge of one particular discipline. The characteristics of modern evils include that they are not always visible, and that most of them lurk behind our intention or actions in the past, grew elsewhere and suddenly emerged in front of us, which makes today's problem more difficult to solve.

In the past, knowledge was integrated at a real level. Dr. Yoshikawa calls it the indigenous knowledge, a combination of observed facts and usages learned by experience. (i.e. how to cure disease by herbs). The scientific knowledge we have at present is, as explained earlier, separated at abstract level. In contrast, the sustainability science in forming the discipline should be consisted of two sets of scientific knowledge in addition to indigenous and scientific knowledge. They are the 'fact knowledge' and the 'use knowledge'. The first is characterized by a set of mutually independent disciplines to understand complexity and the latter is characterized by the ways to integrate separate fact knowledge for creating the values. Although a difficulty arises when

there is no common language between natural and social sciences, the future science – a nightmare research – cannot be made without any integration of knowledge required for future science; integration of natural/physical science, engineering, and social science. A social engineering is a study for such process of integration.

Dr. Yoshikawa further pointed out that it is impossible to solve all the problems dealt by sustainability science at once but is possible to solve step by step. It is because while the traditional science is the science for natural reality and needs analytical deduction, the sustainability science deals with mostly for artifact reality and needs synthesis abduction. Besides the methodologies are less systematized. He mentioned that process for the sustainable science is similar to the evolution of language in that it includes personal selection and social selection; in other words, on the one hand, speaking involves listening, thinking, and speaking, and on the other hand, the sustainable science involves research, application and reflection. Regarding observation, the sustainability science is to be investigated by using four-dimensional lens because it requires examinations of the changeable, considering the chronological order at the same time.

The expected practical results of sustainability science are the sustainability of the earth, not exclusively the prosperity of human beings as traditional science. The conventional science is all about input and output making itself incapable of applying for the integration required. Prof. Yoshikawa concluded his lecture by suggesting the sustainable loop for evolution. There are many actors involved in this loop; observing scientists who explore factual knowledge, engineering scientists who utilize knowledge for sustainability, and other multiple stakeholders who will make and implement policies. These actors move a loop with integrated information and knowledge at various societal levels which is coupled with both manufacturing and adaptation. He commented that we need to reconsider who will create new knowledge and how, emphasizing the qualitative improvement rather than quantitative enlargement. Knowledge we have has contributed to the advancement of today's society but is not good enough for sustainability science. Thus we need to have different outlines and different approach to add up new knowledge.

5

SESSION 3: PANEL DISCUSSION

TOPIC: Climate Change Adaptation – Challenges and Opportunities for higher education

FACILITATED BY: Prof. Akimasa Sumi, Executive Director, TIGS, IR3S, the University of Tokyo, Japan

PANELISTS:

- Prof. S. B. S. Abayakoon, Dean, Faculty of Engineering, University of Peradeniya, Sri Lanka
- Prof. Mazlin bin Mokhtar, Director, Institute for Environment and Development (LESTARI), Universiti Kebangsaan, Malaysia
- Prof. U. C. Mohanty, Center for Atmospheric Science, IIT, Delhi, India
- Prof. Soontak Lee, President, International Association for Environment and Hydrology, Distinguished Professor, Yeungnam University, Korea
- Prof. Mai Trong Nhuan, President, National University of Viet Nam, Viet Nam
- Prof. Sudip Kumar Rakshit, Vice-President, Asian Institute of Technology, Thailand
- Prof. Ir. Tumiran, Head, Faculty of Engineering, Gadjah Mada University, Indonesia

Figure 21: Panel Discussion

In the beginning of the panel discussion, Prof. Sumi introduced the distinguished panelists and the topic. First panelist Prof. S. B. S. Abayakoon congratulated the timely organization of this Conference and emphasized the need to such initiatives in developing world. He further discussed Sri Lankan experiences of climate change and current situations and proposed possible roles for the higher education. In Sri Lanka, natural disasters caused by climate change such as landslides, floods, and droughts, have been very serious problems in recent years. Especially damages brought by the tsunami in 2004 are well known worldwide. Due to an increase in the number of natural disasters both forest and coastal eco-systems have been damaged especially areas in Madu Ganga, a famous wet-land in the country. It can even change the whole ecosystems because only opportunistic species are likely to survive. At this moment relevant institutions are underdeveloped, with no central organization to coordinate stakeholders, lacking in coordination in research and implementation, and of capacity building and education. He summed up his five-minute speech by stressing the role of higher education which, he thinks, should enhance public awareness, instigate effective measures for sustainable recovery, develop new strategies on policy, and initiate a central management unit for overall coordination.

A second speaker, Prof. Mokhtar, started his discussion by presenting current climate change responses in Malaysia. In Malaysia, actions are planned to be taken at multiple levels; international, national, state, and local. A special committee on climate change chaired by the prime minister was launched in the early 2008 to formulate policies at the national level. Internationally UNDP and GEF set up relevant programmes with the environmental ministry of which he emphasized the policy study on climate change which is called 'Ninth Malaysia Plan' (RMK9). In the In terms of the public awareness, it has been increasing since the year 2000, particularly among policy makers. Today, the country is known as a country with higher awareness of the concern on the matter.

Then he briefly introduced some projects conducted by the National University of Malaysia (UKM) whose research institutions are there to serve for multidisciplinary researches and niche areas. As for climate change, the UKM conducts researches with other academic institutions worldwide and most importantly tries to transfer and share knowledge and technology. He maintained that university researchers, in the field of climate change for instance, have stronger voices than before for the policy makers which makes bottom-up approach more feasible.

Third speaker, Prof. Mohanty summarized some aspects of climate change from Indian perspectives. He mentioned that there is no doubt that global warming is real and is happening but more concern actually lies with extreme weather events or high impact weather events. Even with 0.8 degree centigrade temperature rise already happened, very gigantic weather systems like monsoon's intensity is decreasing. If we look at precipitation as a whole in India, there is no major change but very extreme events, too wet and too dry, both are increasing. He quoted Mumbai's extreme precipitation event happened in 2005 where 94 Centimeter rainfall occurred in a single day. Other mega-cities like Bangalore and Chennai are also experiencing heavy flood spells. He informed that in India, total length of monsoon is shrinking. In a country like India which is already exposed to almost all types of natural hazards, such changing pattern of extreme events is a serious concern. Towards this, five government departments of Indian government are working on different aspects of climate change. Department of Earth Sciences mainly covers atmosphere and oceans. Besides that, Department of Space, Department of Science and Technology, Council for Scientific and Industrial Research, and Ministry of Environment and Forest have their programs on climate change. There is a proposal to establish a Climate Change Center to see the impact of climate on different sectors but unfortunately, the biggest drawback is lack of trained manpower. He pointed out that, India, with its one billion populations doesn't even have 100 experts on climate change including experts from all the sectors like agriculture, water resource, energy, and so on. He considers this as major problem and hence feels that this UNU initiative is very timely. This university network will not only create knowledge but also produce qualified manpower in the field of climate change. India established 'National Center for Medium Range Weather Forecast' because country is highly dependency on agriculture. When the center was started, Prof. Mohanty served as head of the research and could hardly enroll 20 students from the entire country to work on climate modeling aspect which can help understand the past climate but still finding it difficult to address uncertainty in future climate regime. He mentioned "unless we tap this component of 'uncertainty', government sectors may find it unconvincing to support research significantly. We cannot have good department of studies because the students have to see where the job is, which must come from private and government sector". He reiterated that we must narrow down on 'uncertainty' and understand other side of the perception. This is an important issue to get good student in this area. He also suggested unless we have good faculty, we cannot produce good students. Hence this UNU initiative to promote regional knowledge, research, education in climate change is very supportive of the demands from this region.

Prof. Lee stressed that climate change has been affecting other sustainable environmental issues such as human health, food security, water resources, social infrastructures and so on. In Korea, a speed of rising temperature is above the average, experiencing the longer summer days and shorter winter days. It needs more investments for, as well as, cooperation among universities, so that they can raise awareness on the GHGs, build and adapt capacities for climate change. Regarding the higher education, he said that universities take a crucial role to address climate change issues as a holistic strategy. That is to say, the universities have to take issues more seriously and that new programmes for climate change adaptation should be launched to increase the adaptive capacity. The working partners between universities, governments and partner institutions play active roles in a new regional network system on capacity building, particularly in developing countries. By highlighting several topics of his detailed presentation, he stated three major steps to be considered: (1) how to integrate climate change into basic and higher education curriculum, (2) how to promote innovating approaches in both formal and non-formal ways, and finally (3) how to highlight and enhance appropriate technology for adaptation and mitigation.

Prof. Nhuan raised six issues to be discussed during the following days. Firstly climate change is a global challenge causing different levels of different impact on different kinds of people all over the world. Secondly, while admitting that climate change is a danger for all, he suggested that we might discover opportunity which is still unknown. Thirdly, adaptation and mitigation strategies of climate change should be combined if it aims at sustainable development. Fourth, by suggesting to the idea of University Panel on Climate Change (UPCC), he called for a global network in addition to the local action and national cooperation. As the fifth point, it needs to consider time scheme either to carry long term or immediate actions. Finally as opportunities for higher education, he pointed out that there is an urgent need for new specialists for interdisciplinary science, that is, sustainability science in which a capacity building is the most important. With the idea of the UPCC, he suggested that the universities should have more joint training schemes and increase the mobility for students and staff members to become global citizens.

Prof. Rakshit, firstly introduced his institute, Asian Institute of Technology which celebrates its 50th year anniversary in this year 2009. The programme on sustainable development covers various sub-areas such as (1) vulnerability and risk reduction, (2) resilience and livelihood strategies, (3) urban and rural sustainability, (4) water and food security, (5) energy security and low carbon society, and so on. Secondly he introduced one of the World Bank reports in which a Japanese officer Mr. Taniguchi says, "Adaptation is also (note: with speaker's stress) important." He reiterated as other panelists that adaptation and mitigation need to go together. Although we have to deal with uncertainty, we do have to make policies and that is the reality we have faced today with endless debates at the international level. He shared rather a pessimistic view over the upcoming conference in Copenhagen, stating that it would be difficult for anyone to see clear strategies in the next phase.

Yet he said that adaptation strategy needs to go on. To conclude he gave a brief thought on Dr. Yoshikawa's speech in which he mentioned the necessity of the closed-loop manufacturing. Although a model of this kind once it includes manufacturing is complicated and has difficulties with how to realize, he takes it as an interesting example of being innovative.

The last speaker Prof Tumiran, presented the student community service programme which has been introduced at his university, Gajamadah University in Indonesia. The programme has now become a compulsory subject for undergraduate students through which they will be working in a rural village for two months. The students work with staff of the faculties, of the local government and of NGOs so that they can gain experiences from interdisciplinary insights. For the faculties and non-academic staff, it also helps to gain the feelings of cross-field cooperation between local governments and universities, and between university faculties. One of the examples includes that students have developed solar cell for the village. It has been useful for those who are in local communities because they can gain practical experience in adapting climate change so that they can develop their own strategy. Furthermore, sharing experiences and transferring adapting knowledge to the other is essential. He stressed that in this way the existing public awareness discrepancies over climate change can be diminished.

Discussion

Followed by the presentations of the panelists, the discussion was opened to the floor. Asked whether higher education has enough capacity to deal with climate change adaptation, one of the panelists argued that the limited funding can bring a serious problem unless national governments work harder to allocate financial resources. This implicates that we have to start from the public sector before discussing how to bring innovative ideas of the private sector into higher education. However there is evidence that even a collection of a little money with limited resources can help to make renovation. Clearly there is a gap between scientific and political communities with no common language and no way of communication which suggests that all the stakeholders, including engineers, scientists, policy makers, and others, have to make effort to sit together and coordinate. It is pointed out from one of the panelists that it is essential to encourage young policy makers to work with universities so that they can see how knowledge is created and how it can cooperate with other actors at various levels. As for cooperation between universities and private sector, two of the panelists shared their own view, stating that such cooperation is increasing and has started to make a difference. One noted that the private sector is the most enthusiastic in an area where technology counts such as hydrogen production and water resource management. Also the sponsorship by the private sector is increasing due to increasing awareness of CSR-related corporate strategies, as well as due to more accessible knowledge and information from the ICT. With the sponsorship, the

local universities and research institution can invite internationally prestigious academics and have learning opportunities. Alongside the private sector funding, governments need to create some form of the support specially to help small and medium sized enterprise.

The panel discussion was closed by Prof. Sumi's remarks in which he questioned the quality of higher education and reiterated the importance of the university as a place for (1) training future leaders, (2) approaching policy makers in the present society. This is because higher education takes a role to create new rules for present/future societies. To serve these interests, the university has to have multifaceted visions, which are, long- and short term visions, as well as global and local visions. Regarding the uncertainty that lingers over climate change and other sustainable development challenges, he pointed out that people by nature tend to label things as uncertain whenever we find any inconvenience and insecurity from them. It is not too much to say it is not totally sure what the 2100 climate will be like. Therefore, we need to step forward by solving today's problems which may lead us to solve problems in the future. In closing his speech, he suggested that we should be more positive and extend coordination among each other.

6

SUMMARY AND OUTCOMES

BACKGROUND

During 10-12 June, 2009, representatives from more than 18 universities and research organizations from across the Asia-Pacific, as well as international and intergovernmental organizations, gathered at UNU headquarters in Tokyo to put higher education on top of the climate change adaptation agenda. The first of its kind in the region, the three-day event entitled *The Role of Higher Education in Adapting to Climate Change* was jointly organized by the UNU Institute for Sustainability and Peace, and the Institute for Integrated Research System for Sustainability Science (IR3S) of the University of Tokyo.

The event successfully established a regional network that will provide the foundations for a comprehensive postgraduate educational programme to produce the necessary students, educators, and research needed for effective adaptation to climate change. More than 100 educators, researchers, policy makers and administrators participated.

The first day of the event, June 10, was a public conference featuring four keynote speakers: Prof. Janette Lindesay, Deputy Director, Australian National University Climate Change Institute; Prof. Diqiang Li, Director, Chinese Academy of Forestry; Prof. Nobuo Mimura, Director, Institute for Global Change Adaptation Science; and Prof. Hiroyuki Yoshikawa, Director-General for The Center for Research and Development Strategy, Japan Science and Technology Agency. Panelists were drawn from presidents, deans and heads of departments from leading universities in Japan, Sri Lanka, South Korea, India, Malaysia, Vietnam and Indonesia.

During the two-day closed workshop that followed, participants shared information on existing climate-related teaching and research within their institutions, with the final day dedicated to brainstorming innovative ideas for a regional curricula, joint research projects and resource sharing, as well as future action plans. The conclusion of the event was celebrated by a round-table commitment to further develop this initiative, with follow-up workshops to be held in 2009 in Vietnam (August), Ghana (October), and in 2010 Indonesia (March).

PARTICIPATING UNIVERSITIES

All the participating universities and research institutions agreed to establish an institutional platform of universities and partner research

institutions to further climate change adaptation agenda in higher education sector. Representatives from following lead universities or their affiliated institutions from Asia-Oceania Region have consented to be a part of this platform:

1. National University of Viet Nam, Viet Nam
2. Asian Institute of Technology, Thailand
3. Faculty of Engineering, Gadjah Mada University, Indonesia
4. Department of Civil Engineering, University of Tokyo, Japan
5. Climate Change Institute, Australian National University, Australia
6. Institute of Forest Ecology, Environment and Protection, Chinese Academy of Forestry, China
7. Center for Water Environment Studies, Ibaraki University, Japan
8. Faculty of Engineering, University of Peradeniya, Sri Lanka
9. Institute for Environment and Development (LESTARI), Universiti Kebangsaan, Malaysia
10. Center for Atmospheric Science, Indian Institute of Technology, Delhi, India
11. International Association for Environment and Hydrology / Yeungnam University, Korea
12. Department of Civil Engineering, Institute of Engineering, Nepal
13. National Hydraulic Research Center, University of the Philippines
14. Department of Civil Engineering, Bangladesh University of Engineering and Technology, Bangladesh
15. Graduate Program on Sustainability Science/IR3S/TIGS, University of Tokyo, Japan
16. Disaster Prevention Research Institute, Kyoto University, Japan
17. Graduate School of Asia-Pacific Studies, Waseda University, Japan
18. Ritsumeikan Asia Pacific University, Japan
19. Faculty of Policy Management, Research Director, Global Security Research Institute, Keio University, Japan
20. Learning to Live with Climate Change Programme, Open University, UK
21. Institute of Sustainability and Peace, United Nations University (Secretariat)

OUTCOMES

1. Establish a panel of eminent scholars from the Asian region to guide the network´'s activities: It is decided to set-up a Steering Committee to guide and advice the universities platform. It is suggested to draw elite champions from outside of this proposed platform to act as members of the Steering Committee.

2. Establish two sub-groups focused on developing the educational programs and research projects, and which act as central point between the steering committee and local universities;

3. Establish UNU as the secretariat to the network, coordinating activities and acting as a repository for education programs and research outcomes

The parallel discussion among two groups centred on:

Research and resource sharing

The group identified different mechanisms which can be explored or adopted to conduct joint research in order to propose most suitable mechanism for developing an adaptation oriented research agenda. The groups also tasked to identify - important research topics, training needs for research and opportunities and resources to share.

The group has identified following mechanisms to conduct joint research:

1. Exchange faculty/researchers with NGO´'s and private partnership: considering that in most developing countries, international donors find it more conducive to fund NGO´'s. Moreover, capacity development is one of the major areas usually addressed through donor support. Private sector and businesses may also facilitate researchers exchange as a part of corporate social responsibility.

2. Joint scientific workshops : To discuss specific needs, sharing local issues in confirming to global issues.

3. Exchange of data/methods from all sources : sources includes academe, NGO´'s, private sector, etc.

4. Submit joint project proposals to funding agencies

5. Create a platform: For/from joint research to disseminate/ share prediction information, impact studies.

6. Knowledge bank: Create a knowledge archive/inventory/database/-toolbox.

Following mechanism is recommended to adopt to develop a research agenda:

1. Human platform: to be headed and guided by a Steering Committee

2. Meta network: Elite/Champions/Identified Group to develop the research agenda (super group and also nodal/local groups/ stakeholders)

Following research areas are identified assuming use of integrated/holistic approach:

1. Downscaling/up scaling studies; understanding global/local conditions; analysing scales of fluctuations

2. Data interoperability/decision support systems

3. Humid tropics, tropical/subtropical regions climate change research (believing that IPCC reports are bias on temperate countries)

4. Vulnerability to extreme weather conditions/events/disasters (landslides, debris flows, flooding, droughts) mapping

5. Identification of mitigation/co-benefits (for example - waste management)

6. Climate prediction for agriculture adaptation and/or its impact on human migration

7. Monitoring, evaluation, benchmarking (ME, KPI)

8. Coastal management

9. Efficient, effective, renewable and clean energy; transportation and linkage to mitigation and adaptation

10. Economics/policies/laws/ethics/governance

11. Adaptation to biodiversity and forestry

12. Water resources management (e.g, translate climate change parameters to water management design/operation parameters)

Training needs for research and development were identified as:

1. Refresher courses for researchers.

2. Training for researchers for in-depth knowledge about models / methods / technologies.

3. Exposure (through study tours) for researchers/managers/policy makers.

4. Coordination/Management/leadership training.

Following opportunities and resources are identified to share:

1. Information/knowledge/models/data (GEOSS, JAXA, ADPC, WMO, UNU, UT, AIT, OPEN Univ, etc) Human resources
2. Equipment/technology (JAXA, GEOSS, UNU, etc)
3. Backstopping (expert on-spot training)
4. Funds (monetary assistance, grants) from JICA, APN, ADB, WB, GEF
5. Integrating national know-how into international programs

Curriculum development

The group was suggested to discuss type of academic degree to be offered either with major in climate change with flexibility to specialize in a particular discipline or with a minor in climate change within related discipline. For the particular type of academic degree (double or joint) generic and specific components to be offered was also discussed. Delivery mechanisms such as e-learning, video conference, class room type for ensuring transferability, hands on experience; accreditation needs and evaluation for sharing credits; training needs; resource sharing etc were also suggested to discuss in the group.

General Observations

1. Curriculum in climate change is very timely in which opportunities are great and demand is large.
2. It is important to keep reasoning while developing curricula: why we are developing a curricula; whom we are delivering and so on. This is important as this curricula is needed to rapidly upscale capacities in a wise way.
3. Gaps in exist in current curricula. Current approach of fragmented knowledge and skills need to shift towards new thinking to integrated multi disciplinary proactive learning opportunities. Present curricula are based on current understanding of problems where recognition of the nature of problem is negligible. It is urgent to áct rapidly.
4. COP meeting is expected to further boost consensus on tackling the severity of climate change may provide right forum to (a) educate policy makers (b) bring policy makerś consensus to push education for climate change agenda.

Needs:

1. Element of flexibility is a must for a curriculum which is focussing on adaptation to changing climate to ease is adaptation to local context. Recognizing that adaptation to climate change is going to be evolving and dynamic process, the curricula need to be flexible while agreeing to basic principles.

2. Curricula should address needs of various groups: citizens, communities, local governments and national policy makers, business.

3. It is important to periodically evaluate the courses and get them accredited through internationally recognized agencies or group of academics or experts. This will help streamlining teaching materials, approaches, combination of theory and field oriented subjects, number of teaching hours and duration of the assignments, research and theses etc.

4. A range of delivery modes should be pursued where UNU is expected to act as web-based clearing house (as collection point of content), taking care of IPR intellectual property rights, promote free sharing of content, means for sharing online resources, means of hands-on delivery, student and staff exchange etc.

Actions:

TWO TYPES OF MASTERS DEGREES ARE PROPOSED - one which offers specific technical and vocational expertise and the other which offers broad scope of challenges and perspectives on climate change. This is important because developing world needs specialists with broader understanding of the scope of issues.

THE PROPOSED CURRICULA are not specific courses, but a program or a suite of climate change courses that will enable potential users, departments, and institutions to select appropriate courses to develop modules that meet their needs. The courses will have the following features:

GENERIC PRINCIPLES forming core courses that may include ? climate change science, impacts and vulnerabilities, mitigation and adaptation, climate related services (policy, law, institutions, economics, instruments) and decision making etc.

CROSS-CUTTING ISSUES that may include - systems approaches and integration, including working with circularity; decision making under uncertainty (considering risk is no longer what we dealing with, but uncertainty, which is beyond the realm of risk now); resilience (adaptive to governance, social-ecological values etc).

SPECIALISED MODULES on climate modelling, impact studies, vulnerability assessment, development of scenarios in specific local context, resource optimization etc.

FOCUSSED SECTOR SPECIFIC COURSES to address issues in water, agricultural, infrastructure, biodiversity, humanitarian assistance sectors

MEANS FOR SHARING ONLINE RESOURCES: It was opined that the skeleton of this online initiative may be initiated by UNU. Open University is willing to assist in this endeavour. UNU will consider various open source as well as other feasible options to build this platform. This will help all the universities involved to propose a particular topic or range of issues which are of common concern. Similarly, joint development of proposed curriculums and specific case-studies from various geo-climatic and socio-economic settings may act as rich reserve of information available to participating universities at ease. Moreover, this internet based mechanism can help structured dissemination of information about the network and specific curriculums adopted in different countries which can facilitate the universities world over to seek academic student exchange and collaboration on mutual interests.

TRAIN THE TRAINERS WORKSHOPS: Once the network start functioning and receives attention from universities elsewhere, there will be room for further seeding the efforts in vulnerable parts of the world. Hence, faculties from other universities in the same countries, from different countries as well as from different continents may seek training opportunities to become teachers in climate change. This can and should be facilitated through this university network which is first of its kind in this field.

SIMILARLY, STUDENT EXCHANGE is proposed to further complementing studentsĺearning from one university with the help of other partner universities. Credit sharing and recognition of courses offered among network partners will be implemented to facilitate this process in an acceptable manner.

INTERACTION WITH OTHER PARALLEL PROCESS : climate change is talked about in almost most of the forums in the world irrespective of disciplines. There are many other movements and initiatives which specifically supports research, promote exchange of knowledge, facilitate field visits, address particular segment of society or region with climate-change considerations and so on shall be considered parallel processes. This network may recognize such processes including academic programs offered by universities in global north which are relevant to climate change studies. Interaction with such parallel initiatives and processes will help avoiding duplication while ensuring sharing of knowledge and results. This will also be proved more effective in developing synergies with non-academic sectors and practitioners.


UNITED NATIONS
UNIVERSITY

UNU-ISP

Institute for Sustainability and Peace
53-70, Jingumae 5-chome
Shibuya-ku, Tokyo 150-8925, Japan
Tel: +81-3-5467-1212
Fax: +81-3-3499-2828
E-mail: mbox@unu.edu
Website: http://www.isp.unu.edu