

Hokkaido University International Symposium on Sustainable Development



Date 7-9 August, 2006

Place Hokkaido University, Sapporo, Japan

URL: <http://www.hokudai.ac.jp/huisd/>

**Hokkaido University
International Symposium on
Sustainable Development**

Preface

It was a great honor for Hokkaido University to host the International Symposium on Sustainable Development on 7-9 August, 2006.



First of all, I would like to express my deep appreciation to all persons who contributed themselves in making the symposium successful. We are delighted to see that we had over 900 participations from 19 countries and regions at the symposium, and that the symposium has provided an opportunity to promote international collaboration in both education and research on sustainable development by transcending academic, national and regional boundaries. As was agreed at the end of the symposium, we have begun the process to create new collaboration network named "Hokudai Network for Global Sustainability". We will present the framework of the network to you in the near future. In the symposium, speakers provided thoughtful presentations and participants created meaningful discussions, therefore, we decided to keep a record of their summary here in the booklet. It will be our great pleasure if the booklet will be a medium for further fruitful discussion on sustainable development.

Hokkaido University has committed to continue the activities on sustainable development with an emphasis on five representative academic fields, such as "Global Warming", "Integrated Water Management", "Establishment of a Recycle-Oriented International Community", "Stabilized Securement of Food and Forest", and "Measures against Infectious Diseases". In order to achieve effective and productive collaboration, we are longing for your continuous support and active cooperation.

Finally, we would like to inform you that we have a plan to host second international symposium on sustainable development in 2009. We will be looking forward to meeting many of you again in Sapporo for further discussion on sustainable development.

Thank you again for your strong support and contributions to our activities.

Mutsuo Nakamura
President
Hokkaido University

Hokkaido University International Symposium on Sustainable Development - Program -

Sunday, August 6

Registration & Welcome Party

6:00pm - 7:30pm	<i>Registration at Hokkaido University Conference Hall</i>
	<i>Welcome Party at Hokkaido University Centennial Hall</i>

Day One: Monday, August 7

Plenary Sessions: Comprehensive View of Sustainable Development

at Hokkaido University Conference Hall - Auditorium A

8:00am -	<i>Registration</i>
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Opening

8:30am - 9:00am	<i>Opening Address</i>	
	<i>Mutsuo Nakamura, Hokkaido University</i>	
	<i>Congratulatory Speech by Guest of Honor</i>	
	<i>Daisuke Machida, International Science and Technology Affairs Division, Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan</i>	...P1-2
	<i>Presentation: Background of This Symposium-Hokkaido University International Symposium on Sustainable Development-</i>	
	<i>Takeshi Kishinami, Hokkaido University</i>	...P3-6

Keynote Speech

9:00am - 9:45am	<i>Prospects of the 21st Century with Respect to Sustainability</i>	
	<i>Itaru Yasui, United Nations University, Japan</i>	...P7-20
9:45am - 10:00am	<i>Break</i>	

Session 1. Sustainability of the Earth System

Chairperson: Motoyoshi Ikeda, Faculty of Environmental Earth Science, Hokkaido University ...P38		
10:00am - 10:40am	<i>Creating an Applied Earth System Science: Linking Global Environmental Change Science to Sustainability Issues</i>	
	<i>Kevin J. Noone, International Geosphere-Biosphere Programme (IGBP), The Royal Swedish Academy of Sciences, Sweden</i>	...P21-26
	<i>Glacial Inceptions: Past and Future</i>	
10:40am - 11:20am	<i>Lawrence A. Mysak, Department of Atmospheric and Oceanic Sciences, McGill University, Canada</i>	...P27-33
11:20am - 11:50am	<i>Ecological Constraints on System Sustainability</i>	
	<i>Takashi Kohyama, Faculty of Environmental Earth Science, Hokkaido University</i>	...P34-37
11:50am - 1:00pm	<i>Lunch Break</i>	

Session 2. Sustainable Society with Recycling System

Chairperson: Yoshimasa Watanabe, Graduate School of Engineering, Hokkaido University ...P61

	<i>Recovering Sustainable Water from Wastewater</i>	
1:00pm - 1:40pm	Takashi Asano, Department of Civil and Environmental Engineering, University of California, Davis, U.S.A.	...P39-48
	<i>Mottainai : A Comparative Study of the Politics of Innovation in Waste Management</i>	
1:40pm - 2:20pm	Miranda Schreurs, Department of Government and Politics, University of Maryland, U.S.A.	...P49-56
	<i>Sustainable and Cyclical Economy of Asia: Overview</i>	
2:20pm - 2:50pm	Fumikazu Yoshida, Graduate School of Public Policy, Hokkaido University	...P57-60
2:50pm - 2:55pm	<i>Break</i>	

Session 3. Emerging Infections and Global Environment

Chairperson: Tsukasa Seya, Graduate School of Medicine, Hokkaido University ...P73

	<i>Origin and Evolution of Influenza Virus</i>	
2:55pm - 3:35pm	Robert G. Webster, Department of Infectious Diseases, St. Jude Children's Research Hospital, U.S.A.	...P62-67
	<i>Are We Prepared for Emerging Zoonoses?</i>	
3:35pm - 4:05pm	Hiroshi Kida, Research Center for Zoonosis Control, Hokkaido University	...P68-72
4:05pm - 4:20pm	<i>Break</i>	

Session 4. Sustainability Governance on Food and Bioresource

Chairperson: Yutaka Saito, Sustainability Governance Project (SGP), Hokkaido University ...P97-98

	<i>Understanding and Approach to "Sustainability" Science of Fisheries</i>	
4:20pm - 4:50pm	Teisuke Miura, Graduate School of Fisheries Sciences, Hokkaido University	...P74-77
	<i>Strategy towards Achievement of Sustainable Agriculture for Food, Energy and the Environment in the Age of the Globalization</i>	
4:50pm - 5:30pm	Nasir El Bassam, International Research Centre for Renewable Energy (IFEED), Germany	...P78-91
	<i>The Sustainability of the Bio-production Systems</i>	
5:30pm - 6:00pm	Mitsuru Osaki, Sustainability Governance Project (SGP), Hokkaido University	...P92-96
6:00pm - 7:00pm	<i>Move to Hotel</i>	

Reception hosted by Mutsuo Nakamura, President of Hokkaido University

7:00pm - 9:00pm	at Keio Plaza Hotel Sapporo: Kita 5 Nishi 7 Tel +81-(0)11-271-0111 Fax +81-(0)11-271-7943
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Day Two: Tuesday, August 8

Parallel Session 1:

International Symposium - How to Sustain Agrosphere, Biosphere and Geosphere

at Hokkaido University Conference Hall - Auditorium A

8:00am -

Registration

Opening

Opening Remarks

Yoshihito Osada, Hokkaido University

8:30am - 9:00am

Mitsuru Osaki, Sustainability Governance Project (SGP), Hokkaido University

...P170-173

Takashi Kohyama, Faculty of Environmental Earth Science, Hokkaido University

Morning Session:

Progressive Approach on the Sustainable Fisheries Management

9:00am - 9:20am

Creating "Safe and Worry-Free" Salmon Products Using a HACCP System Form Fishing through Processing to Distribution

Mamoru Yoshimizu, Graduate School of Fisheries Science, Hokkaido University

9:20am - 9:40am

Genetic Approach to Management and Sustainable Use of Marine Bio-Resources

Syueichi Abe, Moongeum Yoon and Noriko Azuma, Graduate School of Fisheries Science, Hokkaido University

9:40am - 10:00am

The Shiretoko World Natural Heritage Including Marine and Land Ecosystems: Towards Coexistence with Marine Diversity and Fisheries

Yasunori Sakurai and Masahide Kaeriyama, Graduate School of Fisheries Science, Hokkaido University

Roles of the Coupled System of Biosphere and Geosphere

10:00am - 10:20am

Development of an Integrated Ocean Model for Understanding Changes in Ecosystem in the Western North Pacific Associated with Global Warming

Yasuhiro Yamanaka, Graduate School of Environmental Science, Hokkaido University

10:20am - 11:00am

Coffee Break and Poster Session

11:00am - 11:20pm

Material Transports from River to Ocean and Their Contribution to Marine Biological Productivity

Takeshi Nakatsuka, Institute of Low Temperature Science, Hokkaido University

11:20am - 11:40am

Present and Future of Terrestrial Ecosystem Models: Modeling Atmosphere-Vegetation Interactions

Toshihiko Hara, Institute of Low Temperature Science, Hokkaido University

11:40am - 12:00pm

21st Century Center of Excellence Program 'Prediction and Avoidance of an Abrupt Change in Bio-Geosphere System'

Motoyoshi Ikeda, Faculty of Environmental Earth Science, Hokkaido University

12:00pm - 1:00pm

Lunch Break

Afternoon Session

1:00pm - 1:20pm *Sustainable Food, Water and Energy in Asia*
Kensuke Fukushi, IR3S, University of Tokyo, Japan

3rd Biomicrocosmos Workshop: Sustainability and Security of Food Production

1:20pm - 1:35pm *Importance of Rhizosphere Research for Sustainable and Safe Food Production*
Jun Wasaki, Creative Research Initiative 'Sousei' (CRIS), Hokkaido University

1:35pm - 1:55pm *Soil Quality Evaluation and Sustainable Agriculture Development in the Region of Southwest Yunnan, China*
Zhang Naiming, Yunnan Agriculture University, China

1:55pm - 2:15pm *Arsenic Contamination of Groundwater: Food Safety and Human Health Hazard in Bangladesh*
M. Harun-ur-Rashid, Bangladesh Agricultural Research Institute, Bangladesh

2:15pm - 2:35pm *Improvement of P Uptake from Acid Soil by Transgenic Plants with Modified Citrate Metabolism*
Hiroyuki Koyama, Gifu University, Japan

2:35pm - 3:20pm *Coffee Break and Poster Session*

3:20pm - 3:40pm *Mycorrhizal Fungi in the Tropical Rain Forest of Indonesia and its Utilization for Reforestation*
Keitaro Tawaraya, Yamagata University, Japan

Integrative Perspective on the Sustainable Earth

3:40pm - 4:00pm *Latest Progress on Land System Studies in China*
He-Quing Huang, Chinese Academy of Sciences, China

4:00pm - 4:20pm *Prospects and Roles of Global Land Project*
Billie Turner, Clerk University, U.S.A.

4:20pm - 4:30pm *Break*

4:30pm - 5:30pm *Concluding Discussion*

6:30pm - 8:00pm *Welcoming Party at Restaurant ELM in the Faculty House ENREISO*

Day Two: Tuesday, August 8

Parallel Session 2:

Protection of Society from Infectious Threat

at Hokkaido University Conference Hall - Auditorium B

8:00am -

Registration

Morning Session

Opening

9:30am - 9:35am

Welcoming Address

Takashi Umemura, Graduate School of Veterinary Medicine, Hokkaido University

9:35am - 9:40am

Opening Remarks

Hiroshi Kida, Research Center for Zoonosis Control, Hokkaido University...P174-176

Session 1

9:40am - 10:20am

Ecology and Evolution of Influenza Viruses, Preparation for the Occurrence of Highly Pathogenic Avian Influenza and the Possibility of a Human Pandemic of Influenza

Robert G. Webster, Department of Infectious Diseases, St. Jude Children's Research Hospital, U.S.A.

10:20am - 10:50am

Computer Analysis for the Prediction of Structural Changes in Hemagglutinins of Future Antigenic Variants of Influenza Viruses

Kimihiko Ito, Research Center for Zoonosis Control, Hokkaido University

10:50am - 11:20am

Coffee Break

Session 2

11:20am - 12:00pm

Deciphering Mechanisms of Prion Transmission Using Transgenic Mice

Glenn C. Telling, Department of Microbiology, Immunology and Molecular Genetics, University of Kentucky, U.S.A.

12:00pm - 12:30pm

Tuberculosis: Research for Control Measures

Yasuhiko Suzuki, Research Center for Zoonosis Control, Hokkaido University

12:30pm - 2:00pm

Lunch Break

Afternoon Session

Session 3

2:00pm - 2:40pm

Bats, Civets and Emergence of SARS

Lin-Fa Wang, CSIRO Livestock Industries, Australian Animal Health Laboratory, Australia

2:40pm - 3:20pm

Japanese Encephalitis Molecular Epidemiology Implies Possible Rapid West Nile Virus Expansion: Development of West Nile Fever Vaccines

Kouichi Morita, Institute of Tropical Medicine, Nagasaki University, Japan

3:20pm - 3:50pm

Epidemiology and Pathogenesis of Ebola Hemorrhagic Fever

Ayato Takada, Research Center for Zoonosis Control, Hokkaido University

3:50pm - 4:20pm

Coffee Break

Session 4

4:20pm - 5:00pm

Control of Echinococcosis - the State of the Art

Thomas Romig, Dept. of Parasitology, University of Hohenheim, Germany

5:00pm - 5:30pm

African Trypanosomiasis

Chihiro Sugimoto, Research Center for Zoonosis Control, Hokkaido University

5:30pm - 5:35pm

Closing Remarks

Ikuo Takashima, Graduate School of Veterinary Medicine, Hokkaido University

Day Two: Tuesday, August 8

Parallel Session 3:

Sustainable Metabolic System of Water and Waste for Area-Based Society

at Hotel Royton Sapporo

Group 1. Innovation of Membrane Technology for Water and Wastewater Treatment - IMTEC Sapporo -

8:30am -

Registration

Morning Session

Opening

9:00am -

Opening Address and a Brief Report on the Current Status of Membrane Technology in Japan
Yoshimasa Watanabe, COE Program Leader, Hokkaido University ...P177-179

9:40am -

Track for Wastewater

Moderator: Kazuo Yamamoto, Environmental Science Center, University of Tokyo, Japan
Performance of Pre-denitrification Submerged Membrane Bioreactor (MBR) under Various Solid Retention Times

9:40am - 10:30pm

Speaker: Ong Say Leong, Center for Water Research, Division of Environmental Science & Engineering, National University of Singapore, Singapore

Effect of SRT on Membrane Fouling and Performance

Discusser: Hang-Sik Shin, Department of Civil and Environmental Engineering, KAIST, Korea
An Approach towards a Better Understanding of Fouling Phenomena in MBR

10:30am - 11:20am

Speaker: Roger Ben Aim, Laboratory of Environmental Engineering (LIPE), INSA Toulouse, France

An Alternative Approach towards a Better Understanding of Fouling Phenomena in MBR
Discusser: Duu-Jong Lee, Department of Chemical Engineering, National Taiwan University, Taiwan

Membrane Biofouling in the MBR Treating Domestic Wastewater: Identification of Key Players in Membrane Biofouling

11:20am - 12:10pm

Speaker: Satoshi Okabe, Graduate School of Engineering, Hokkaido University

Is Biofilm Formation The Key Player in MBR Biofouling?

Discusser: Guang-Hao Chen, Department of Civil Engineering, Hong Kong University of Science & Technology, China

12:10am - 1:30pm

Lunch Break

Afternoon Session

1:30pm -

Track for Drinking Water I

Moderator: Shin-ichi Nakao, School of Engineering, University of Tokyo, Japan

Nanomaterials and Membranes for Water and Wastewater Treatment

1:30pm - 2:20pm

Speaker: Mark R. Wiesner, Pratt School of Engineering, Duke University, U.S.A.

Nanosized Materials in Membrane Applications

Discusser: Yoshihiko Matsui, Graduate School of Engineering, Hokkaido University

Mechanism Involved in the Evolution of Irreversible Fouling in Microfiltration (MF) and Ultrafiltration (UF) Membranes Used for Water Treatment

2:20pm - 3:10pm

Speaker: Katsuiki Kimura, Graduate School of Engineering, Hokkaido University

Discussion of "Mechanism Involved in the Evolution of Irreversible Fouling in Microfiltration (MF) and Ultrafiltration (UF) Membranes Used for Water Treatment by Kimura et al. (2006)"

Discusser: Gary Amy, Institute for Water Education, UNESCO IHE, The Netherlands

3:10pm - 3:30pm	<i>Break</i>
3:30pm -	<i>Track for Drinking Water II</i>
	Moderator: Yoshimasa Watanabe , Graduate School of Engineering, Hokkaido University
	<i>Recovery of Spent Filter Backwash Water Using Coagulation-Assisted Membrane Filtration</i>
	Speaker: Chihpin Huang , Institute of Environmental Engineering, National Chiao Tung University, Taiwan
3:30pm - 4:20pm	<i>Discussion for "Recovery of Spent Backwash Water Using Coagulation-Assisted Membrane Filtration"</i>
	Discussor: So-Ryong Chae , Graduate School of Engineering, Hokkaido University
	<i>Low Pressure Membrane Filtration for Drinking Water Production in Germany : State of the Art and Future Developments</i>
	Speaker: Stefan Panglisch , Department of Water Technology, IWW Water Center, Germany
4:20pm - 5:10pm	<i>Comment on "Low Pressure Membrane Filtration for Drinking Water Production in Germany State of the Art and Future Developments"</i>
	Discussor: Chung-Hak Lee , School of Chemical and Biological Engineering, Seoul National University, Korea
5:10pm - 5:30pm	<i>Closing</i>
6:00pm -	<i>Party</i>

Day Two: Tuesday, August 8

Parallel Session 3:

Sustainable Metabolic System of Water and Waste for Area-Based Society

at Hotel Royton Sapporo

Group 2. Strategy for Sustainable Solid Waste Management

8:30am -	<i>Registration</i>
<i>Opening</i>	
1:30pm -	<i>Opening</i> Toshihiko Matsuto , Graduate School of Engineering, Hokkaido University
<i>Session</i>	
1:40pm - 2:40pm	<i>Waste Management, an Integrated Part of Sustainable Resource Management</i> Paul H. Brunner , Institute for Water Quality, Resource and Waste Management, Vienna University of Technology, Austria
2:40pm - 3:40pm	<i>Sustainable Land Disposal: Definitions and Possible Approaches</i> Luis F. Diaz , Calrecovery, Inc., U.S.A.
3:40pm - 4:00pm	<i>Coffee Break</i>
4:00pm - 5:00pm	<i>Integrated Strategy of Recycling in Korea</i> Dong-Hoon Lee , Department of Environmental Engineering, University of Seoul, Korea
5:00pm - 5:30pm	<i>Discussion</i>
5:30pm -	<i>Closing</i>

Day Three: Wednesday, August 9

Plenary Sessions: Prospects for Means of Solution

at Hokkaido University Conference Hall - Auditorium A

Session 1. Roles of Higher Education and International Collaboration for Sustainable Development

Chairperson: Takeshi Kishinami, Hokkaido University

Co-Chairperson: Midori Yamagishi, Hokkaido University

...P125-127

Keynote Speech

9:00am - 9:30am *Education for Sustainable Development: If Not the Solution, At Least a Start*
Sheldon Shaeffer, UNESCO Asia and Pacific Regional Bureau for Education,
Bangkok, Thailand ...P99-110

Panel Discussion

Coordinator: Norihito Tambo, University of the Air, Japan

...P111-113

Panelists:

John Cusick, Environmental Center, University of Hawai'i at Manoa, U.S.A.

...P114-115

Stephen Lincoln, School of Chemistry and Physics, University of Adelaide, Australia

...P116-118

9:30am - 11:30am M. Harun-ur-Rashid, Training & Communication Wing, Bangladesh Agricultural
Research Institute (BARI), Bangladesh ...P119-122

Motoyoshi Ikeda, Faculty of Environmental Earth Science, Hokkaido University

...P123-124

Sheldon Shaeffer, UNESCO Asia and Pacific Regional Bureau for Education,
Bangkok, Thailand

Session 2. Poster Session

Higher Education and Countermeasures for Sustainable Development

11:30am - 12:15pm *Poster Session at Room 1*

12:15pm - 1:15pm *Lunch Break*

Session 3. Countermeasures for Sustainable Development

Chairperson: Oleg Shcheka, Department of International Programs and Projects,

Far Eastern Branch of the Russian Academy of Sciences, Russia

Co-Chairperson: Takayuki Shiraiwa, Research Institute for Humanity and Nature, Japan

...P168-169

Keynote Speech

1:15pm - 1:45pm *Interaction between the Amur River Watershed and the Sea of Okhotsk in the Model
of Sustainable Development*

Petr Y. Baklanov, Pacific Institute of Geography, Far Eastern Branch of the
Russian Academy of Sciences, Russia ...P128-149

1:45pm - 2:05pm *Sustainable Food Production: Integration of Food, Health, Environmental Challenges*
Kalidas Shetty, Department of Food Science, University of Massachusetts,
Amherst, U.S.A. ...P150-153

2:05pm - 2:25pm *The Land Use Change in Northeast of China since 1980*
Bai Zhang, Northeast Institute of Geography and Agricultural Ecology, Chinese
Academy of Sciences, China ...P154-157

2:25pm - 2:40pm *Break*

2:40pm - 3:00pm	<i>An Evaluation of Water Allocation Mechanisms: A Korean Case</i> Dong-Geun Han , School of Economics and Finance, Yeungnam University, Korea ...P158-160
3:00pm - 3:20pm	<i>Challenges and Strategies for the Planning and Design of Sustainable Landscapes</i> Jack Ahern , Department of Landscape Architecture and Regional Planning, University of Massachusetts, Amherst, U.S.A. ...P161-164
3:20pm - 3:40pm	<i>Creating Effective International Regimes: New Approach of Political Science</i> Toru Miyamoto , Graduate School of Public Policy, Hokkaido University ...P165-167
3:40pm - 3:45pm	<i>Summary of This Session</i>
3:45pm - 4:00pm	<i>Break</i>

Session 4. Summary of the Symposium

Chairperson: Takeo Hondoh, Hokkaido University Initiative for Sustainable Development (HUISD)

4:00pm - 4:05pm	<i>Overall Review</i> Takeo Hondoh , Hokkaido University Initiative for Sustainable Development (HUISD)
4:05pm - 4:15pm	<i>Report from Parallel Session 1</i> Mitsuru Osaki , Sustainability Governance Project (SGP), Hokkaido University...P170-173
4:15pm - 4:25pm	<i>Report from Parallel Session 2</i> Hiroshi Kida , Research Center for Zoonosis Control, Hokkaido University...P174-176
4:25pm - 4:35pm	<i>Report from Parallel Session 3</i> Yoshimasa Watanabe , Graduate School of Engineering, Hokkaido University...P177-179
4:35pm - 4:50pm	<i>Discussion</i>
4:50pm - 5:00pm	<i>Closing Remarks: For Our Future Direction</i> Takeo Hondoh , Hokkaido University Initiative for Sustainable Development (HUISD) ...P180-181

Abstracts and Presentations

Congratulatory Speech by Guest of Honor

Daisuke Machida

Director

International Science and Technology Affairs Division,
Ministry of Education, Culture, Sports, Science and Technology
(MEXT), Japan



It is a great pleasure for me to be invited to this international symposium on sustainable development and say a few words on behalf of my ministry, MEXT.

Sustainable development has been recognized as an important issue by the international community for a long time, at least since the Earth Summit in 1992. It is also identified as one of the six goals in the new Science and Technology Basic Plan. Therefore, I would like to congratulate Hokkaido University on launching the new initiative for sustainable development, and I am very glad that MEXT can support this initiative financially under its "Program for reinforcing the headquarters of universities for the strategic promotion of international activities".

Since I am in charge of international science and technology affairs at MEXT, today I would like to talk about a recent policy measure of MEXT with respect to promoting international research activities.

The 3rd Science and Technology Basic Plan, which is the basic guideline for the government policy of science and technology for the next 5 years, proposes to "strategically promote international activities" in the chapter of "Reforming the S&T System". More in detail, it proposes three things:

- (1) To promote systematic efforts of international activities;
- (2) To strengthen cooperation with Asian countries; and
- (3) To promote environment for international activities.

The third one includes to reinforce the administrative system or administrative department of universities and other research institutions involved in international activities. To this end, MEXT started last year a new program to promote organizational and strategic international activities of universities by the name of the "Program for reinforcing the headquarters of universities for the strategic promotion of international activities". The background for starting this program is that there are some problems with traditional international activities at

Japanese universities, that is,

- Most international activities depend on personal efforts of individual researchers;
- As a result, there is too much burden on researchers involved in international activities;
- And those activities are not organizational or strategic;

and

- As an indicator to measure internationalization of Japanese universities, the ratio of non-Japanese academic staff is only 3.5%.

That is the background in which MEXT started the program for 20 universities to operate the headquarters for the strategic promotion of international activities. This program provides financial support for 5 years for various efforts by universities to strategically promote international activities with a view to establishing good models for all academic institutions in Japan. I understand that this symposium is held under the overall strategy of international activities of Hokkaido University.

I think that in Japan, scarce land and natural resources have forced us to develop advanced science and technology that could support sustainable development. Therefore, I am sure that the Japanese scientific community as well as industry has good potential to work on this issue in various fields and that Hokkaido University is one of the leading education and research institution in terms of human resources, research organization, and accumulation of expertise as a whole.

Sustainable development can be a domestic issue in each country, but it is usually considered as global issue because every problem originated in one country affects other countries or at least it is likely to happen in other countries too. So it is not sufficient to work on it within individual institutions or countries, but it is indispensable to collaborate internationally or globally and among different academic disciplines. I hope this symposium will be an excellent occasion for exchanging most updated information on the research on science for sustainable development and strengthening the ties of the international scientific community for the common interest of humanity.

Thank you very much for your attention.

Background of This Symposium

– Hokkaido University International Symposium on Sustainable Development–

Takeshi Kishinami

Vice President

Hokkaido University

E-mail: kisinami@coin.eng.hokudai.ac.jp



Hokkaido University, aspiring to promote its activities in the fields of education, research and social contribution as an internationally characteristic university, is engaged in various activities.

Four major activities to promote internationalization are:

(1) Reinforcement of exchanges with universities worldwide

Hokkaido University has concluded the Exchange Agreements with 141 universities (as of 1 April, 2006), including the Departmental Exchange Agreements, thereby widening the scope of exchanges of faculty members and students. We have, at the same time, been actively holding university-wide bilateral symposiums with our partner universities, thereby strengthening the cooperative activities with the limited number of partners.

(2) Increase in the number of international students

Today over 800 foreign students have been studying on campus at Hokkaido University. We have formulated the "Strategic Plan for International Activities" and have been promoting exchanges with Northeast Asia, particularly China, South Korea and Taiwan, in order to increase the number of international students..

(3) Strengthening international public relations activities and overseas networks

We have newly published and widely distributed the Hokkaido University introductory pamphlet's in Chinese and Korean versions in addition to English. The quarterly-published English and Chinese Newsletter also introduce Hokkaido University's most recent activities in an easy-to-understand manner. We have established a liaison office in Beijing in April 2006 to provide more information and better services for Chinese researchers and students, as well as to support former international students in alumni associations' activities.

(4) Promotion of international cooperation

We concluded the Comprehensive Partnership Agreement with the Japan International Cooperation Agency (JICA) in April 2005, forging a stronger cooperative framework than ever. Furthermore, we have accepted trainees regarding the establishment of a waste disposal system in Inland China in collaboration with the Japan Bank for International Cooperation (JBIC).

In addition to the above mentioned activities, Hokkaido University has started new challenges in the field of Sustainable Development. The concept of sustainable development involves environmental perspectives, such as the responsible use and conservation of the earth's finite resources, as well as economic and social perspectives, such as continued life and prosperity of humanity. Thus, sustainable development contains three elements - environment, economy and society. Sustainable development has become a shared concept in the international community as evidenced by its reoccurrence at various United Nations conferences as well as throughout academia, such as the Science Council of Japan, which, for example, stated that a keyword running through all of its targeted missions is "sustainability, that is, the harmony between environment and economy" in the Principles of Strategic Science and Technology Policy, Japan, which were released in the spring of 2005.

The single phrase "internationalization of universities" actually involves extensive areas and diverse approaches. Our first target is internationalization in the area of sustainable development. We intend to implement strategies concerning research, education and social contribution, by focusing on enhancements of functions in the following four areas: (1) international research partnership; (2) international education partnership; (3) international cooperation, public relations and brand equity; and (4) comprehensive support (services) for international exchanges.

Hokkaido University Initiative for Sustainable Development, established in November 2005, has declared its objectives as follows:

- To make well known to the rest of the world the fact that Hokkaido University has practiced internationally competitive education and research;
- To make the university have a high affinity with the international community and abound in diversity;
- To make greater contributions to the international community through the spread of academic results and policy recommendations as well as the development of international cooperation activities

We at Hokkaido University have enough track record and accumulation of expertise to respond to international demands in extensive academic fields that constitute the foundation of sustainability. The representative academic fields are as follows:

- "Global warming"
- "Integrated water management"
- "Establishment of a recycle-oriented international community"
- "Stabilized supply of food and secured forest"
- "Measures against infectious diseases"

I hope that plenty of fruitful discussion will be made during this international symposium, and your stay in Sapporo will be pleasant and memorable one.

Thank you.

Background of this Symposium

-Hokkaido University International Symposium on Sustainable Development-

August 7, 2006

Takeshi KISHINAMI

Vice President of Hokkaido Univ.

History of Hokkaido University

1876-1907 Sapporo Agricultural College

The First College in Japan to Award Bachelor Degrees

1886 Tokyo Imperial University
1897 Kyoto Imperial University
1907 Tohoku Imperial University

1918-1947 Hokkaido Imperial University

1919 Kyushu Imperial University
1921 Osaka Imperial University
1923 Nagoya Imperial University

1947-2004 Hokkaido University

October, 2001 The 125th Anniversary of the University

April, 2004 National University Corporation Hokkaido University

Hokkaido University
International Symposium on Sustainable Development

Slide-1

Basic Philosophies of Hokkaido University

Frontier Spirit

Global Perspective

All-Round Education

Practical Learning

Hokkaido University
International Symposium on Sustainable Development

Slide-2

17 Graduate Schools & Faculties: Sapporo Campus

Letters
Education
Law Public Policy
Economics & Business Administration
Science
Medicine
Dental Medicine
Pharmaceutical Sciences
Engineering
Agriculture
Veterinary Medicine
Fisheries Sciences
Environmental Earth Science
International Media and Communication
Information Science and Technology
Advanced Life Science

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Slide-3

Four Major Activities to Promote Internationalization

- Reinforcement of Exchange with Universities Worldwide
- Increase in the number of International students
- Strengthening International Public relations Activities and Overseas networks
- Promotion of International Cooperation

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Slide-4

International Academic Exchange: Hokkaido University



Hokkaido University
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Slide-5

Why did we launch Sustainable Development Projects?

1. Hokkaido is located at cross-area of Japan Sea, Okhotsk Sea (covered with ice during winter) and North Pacific Sea
2. Many Field Science Researches regarding to Environmental science, Marine science, Agriculture and Zoonosis in H.U.
3. Strengthening International Collaborative Research between Foreign Universities and Hokkaido University

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Slide-6

Focusing Research Fields on Sustainable Development in Hokkaido University

1. Global Warming
2. Integrated Water Management
3. Establishment of a Recycle-Oriented Eco-System
4. Stabilized Securement of Food and Forest
5. Measures against Infectious Diseases

Hokkaido University
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Slide-7

Background and Aims of this Symposium

1. Sustainable Development has already become the top priority not only in academic circles, but also in the international community.
2. Hokkaido University desires to share scientific recognition with researchers from a broader range of Disciplines beyond national and regional boundaries.
3. To establish scientific consortium or International Collaborative Networks of Research and Education.



Hokkaido University
International Symposium on Sustainable Development

Slide-8

Challenges of this Symposium

1. Sustainability of the Earth System
2. Sustainable Society with Recycling System
3. Emerging Infections and Global Environment
4. Sustainability Governance on Food and Bioresource
5. Roles of Higher Education and International Collaboration for Sustainable Development

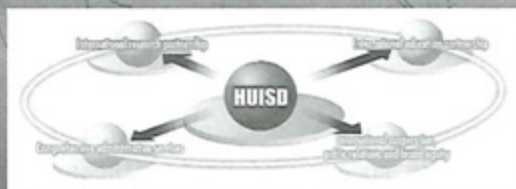


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Slide-9

Benefits through the Symposium

1. International Partnership
2. International Education Partnership
3. International Collaboration and Public Relations
4. Comprehensive Administration Services



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Hokkaido University International Symposium on Sustainable Development

Monday August 7, 2006 / 9:00am-9:45am

Keynote Speaker

Prospects of the 21st Century with Respect to Sustainability

Itaru Yasui

Vice Rector

United Nations University, Japan

E-mail: yasui@hq.unu.edu



—Prof. Kishinami—

The keynote speech of the symposium will be presented by Prof. Itaru Yasui. Prof. Yasui has been the Vice-Rector of the United Nations University since 2003, after working for Tokyo University as a professor. As for the outline of his speech and profile, please refer to the booklet we have distributed. Prof. Yasui, please.

—Prof. Itaru Yasui—

Good morning, ladies and gentlemen, and thank you for the invitation by Hokkaido University. I'm very pleased and honoured to be here and to have an opportunity to deliver a talk.

It's quite hot today, and some say it's probably due to a global climate change. That may be so, but it may not be so. However, I choose "Prospects of the 21st Century with Respect to Sustainability" as the title of my talk, in which I will talk about sustainability, and also about the future. To talk about the future is quite dangerous because I don't have a time machine or magic mirror to tell the future, but I shall try.

Before proceeding, I would like to take a short time to introduce UNU. The UNU is an international community of scholars, and we are a bridge between the United Nations and the international academic community. (DATA 2) Also, we will be or we would like to be a platform for innovative and creative ideas for UN operation. Our name is has a word of "university" in it, but actually we are not a university at all, because we don't have any students or professors, and we are rather just an international committee of scholars. We would like to be a think-tank for the United Nations' system, and we are also doing some capacity building around the world. We have about 13 research training centres all around the world, and the activities in Tokyo are only about 10% of the activities of UNU.

Let's move to the topics, and to start with, some experiences in Japan. Japan is a very

special country, and we have experienced very bad things in our environment. In the 1960s we had the Minamata and Itai-Itai diseases. (DATA 3) These were very bad and due to pollution caused by chemical industries at that time. After that, we happily improved the environmental situation to a great extent. But we had traffic pollution issues and also POPs - persistent organic pollutant issues - in the 1970s. In the 1980s there was illegal dumping of waste, and the 90s was the age of waste management and when we started recycling. In 1997, we had the Kyoto meeting and the so-called Kyoto protocol was founded there. Then, in 1999, some endocrine disrupting compound issues, and from the year of 2000, the sustainability issues started.

In a schematic diagram of the issues, at the top would be dioxin and POPs. We had a very hot issue in 1999 or so, but actually at that time the issues had been solved already, because dioxin emissions in the Japanese environment maximised in 1970, or so. Air pollution is about to be solved, and water and sea pollution may take a little longer to be solved. Endocrine disrupting compound issues can be a problem, but now we have found that it's not such a big issue, at least for human health, although it may have some adverse effects on the eco-system. With the depletion of the ozone layer, we are now waiting for the solution. It's completely down to the capacity of the earth. Soil and sediment pollution may take a long time to be solved because we have already emitted so many of these compounds into the environment in the 1970s and '80s. The other important issues are resource and energy consumption-related issues, and also global warming is a very, very important issue, and the importance is gradually increasing.

Let's go back to the dioxin issue. We had a hot issue in 1998 or '99 or so, but the real emission was due to herbicides named PCP or CNP, in the 1960s, '70s and early '80s. This part is a so-called Coplanar PCB, which is accompanied by the emission of PCB, and these measures are the cause of dioxin pollution in Japan. We had a very strong debate against incineration, but the actual contribution from incineration was very small. I think the overall trend now is that the situation is improving.

The other example is points of measurement of concentration of environmental standard. For example, lead, cadmium, arsenic, PCB and chromium, and others are all decreasing due to the very severe regulations of environmental schemes. The worst situation was in the 1970s, and within only 10 years or so the improvement is very, very quick. After that, still gradual improvement is continuing.

Now, with regards the sustainable development or sustainability, and as a definition of sustainability, I understand we have to think about the future generations. That's the real attitude towards sustainability. In September 2000, the United Nations had a Millennium Summit, where the Millennium Development Goals (MDGs) were agreed. We have 8 MDGs, and for each goal, one or more targets have been set, and certain goals have to be attained before 2015, using 1990 as a benchmark. These are the MDGs: first of all, to eradicate extreme poverty and hunger; achieve universal primary education; promote gender equality and empower women; reduce child



mortality; improve maternal health; combat HIV/AIDS, malaria and other diseases. We had an Earth Summit in 1992, but environmental sustainability was only the 7th item on the MDG. We agreed in 1992 that global environment issues were so important, but in only 8 years we had very different types of important issues.

Now I'd like to explain about the situation. This is the plot of life expectancies of more than 130 countries, with GDP per capita. The dots express all the countries. Japan has the longest life expectancy in the world. Several things can be seen from this figure. First of all, the life expectancy of 70 years of age can be rather easily achieved by a GDP per capita of only about 3,000 dollars. But I think this is a very big problem. So probably 3,000 dollars makes it possible to have a tap-water system for every home, and also children's diarrhoea can be treated using simple medicine. Then the life expectancy can reach 70. I think the human body is rather strong, so even with very advanced medical treatment we can only elongate life expectancy by about 10 years or so. This graph is based on the data for 1995, and when we drew a figure using the data of 2001, some very peculiar points appeared. One country, Luxembourg increased its GDP per capita substantially in this 6-year period. It completely changed the structure of its economy, from steelmaking to banking and other kinds of systems. Apparently, it's a good change if we'd like to have much money.

Four points moved and appeared at different places on the graph. We can congratulate them, but in reality they have dropped from somewhere else. This is the situation for the country of Botswana in Africa, which may not be all that well known to the people of Japan. It's just north of South Africa, and that area is very rich in mineral resources, so they can produce gold, diamonds and the like. So it's a very rich country in Africa. But the situation is something like this. In 1986 or so, the life expectancy exceeded 60 and almost reached 62, but after that it decreased sharply to 38 or so. Of course, you know the reason - HIV/AIDS. They want to do something, but there's no one available with enough power to do anything. This figure shows the importance of the 6th MDG item.

Now let me talk about other topics; this is the global warming issue, and this is a very famous and important figure from the report by IPPC in 2001. This shows the future trends of temperature increases, depending on the emission scenarios. It can be said that this green curve is not so bad, and this broken red line can be enough. But for the others, such as this black one, they are still increasing, so we cannot say where it will go, so we should probably avoid doing so. Taking a look at the emission scenarios corresponding to these curves, the green one is something like this. So the gradual increase of emission of CO₂ up to 2040 or '50 is not too bad, but after that, we have to decrease the emission rather sharply. And for the broken red curves, more increase can be allowed, but after that, the situation is the same.

This is a graph prepared by myself. We can increase emissions up to the year 2050, but after that, we have to decrease rather sharply. That means each country should have this shape of emission scenarios. Some European countries have already started to decrease emission, and Japan is about to start to decrease of CO₂ emissions. In the United States too, someday in the near future they have to start decreasing CO₂ emissions. For the others, this can be a country like Cambodia, where they can increase CO₂ emissions for some time, and then decrease.

Recently there is a new proposal, and this is actually a scenario by NIES, which we call

the 475ppm scenario. According to their calculations, we have to limit the concentration of global-warming greenhouse gases to less than 475ppm in order to keep the temperature increase less than 2 degrees. But we have to be careful about that. This starting point is 1990, but already there is a 0.6-degree increase in that period because they counted the temperature increase after the industrial revolution. So to limit the total increase, it should be less than 2 degrees or so.

The corresponding emission scenario is something like this. This red line shows that from 2020 or so, in less than 10 years we have to decrease the emission by 40%. That's a very big amount, and I have to redraw the figures to something like this. If 475ppm is real, then we have to do something much, much quicker.

This is the trend in risks, and I'd like to divide risks into two categories: one is local; the other is global. The global risks are global warming, population issues, over consumption of resources, food supply, bird flu, etc. In Japan's case the local risks are going down, so probably we have to hope that it is possible to cope with these global risks.

Now I'd like to introduce the concept of environmental transition, and to understand the trend of environmental issues. The historical concept was proposed by a Russian, Professor Kuznets, who showed some figures, not for the environment but for the income of each country. This is the Environmental Kuznets Curve in which SOx concentration in capital area is plotted against GDP per capital in logarithmic scale. If the scale of the economy is very small, there's no pollution at all. But after some economical development starts, the pollution increases and peaks when the GDP is almost the same as the previous value of 3,000 dollars per year per person. After that, the concentration tends to decrease if we attain some economical development. For this region, a good spiral is achieved for the economy and environment. If it is possible for us to attain this curve for the emission of CO₂, I think it's a solution.

Let's take a look at the emission of each country, against GDP per capita. If we look at the emission of CO₂, we will notice that it's impossible to make a discussion using CO₂ emission because one extreme example is for Iceland. Iceland consumes the most amount of energy, but they emit only 8 tons CO₂, or so, per capita, owing to hydropower and also geothermal energy. The conclusion is quite simple: we have to use the idea of the consumption of energy instead of CO₂ emission.



This is the plot of GDP per capita and the energy consumption per capita in oil equivalent. In Japan we consume about 4,000 kg of oil per person per year. Unbelievable it may seem, we each consume 4 tons of energy, annually. So I finally came to the conclusion that we can divide the countries up into (1) oil-producing countries like Bahrain, Kuwait, UAE, Trinidad & Tobago - although Saudi Arabia has improved a little; (2) big countries, like Russia, Canada and the United States; (3) northern countries like Norway; (4) countries like France and Japan, etc.; (5) others like Portugal and Hong Kong; and then (6) tropical countries. It seems like it works, but actually I think this curve is not true. Let's take a look at Luxembourg. Luxembourg is

located just south of the Netherlands, so if only a geographic condition can determine this, then Luxembourg should be somewhere here. In Luxembourg they consume almost twice the energy of neighbouring countries, but maybe there's a different interpretation. If you visit Luxembourg you'll find that the price of gasoline is substantially cheaper than the surrounding countries. The tax in Luxembourg is much less than in Belgium or Germany, so the price of gasoline is much cheaper there. It is possible that Belgium and German people go into Luxembourg to buy gasoline. I don't know whether this spot is reflecting a true figure of the consumption of Luxembourg, or not. If we take a look at the United States, like Japan they are still increasing the consumption of energy, I believe. We are trying to stabilize the consumption of energy, but it's quite difficult. This kind of graph is so optimistic, and probably the real thing is something like that, we cannot be certain.

I'd like to point out some countries, such as Denmark and the UK to some extent, where they have already started to decrease the emission of CO₂. Is there any explanation why European countries are so eager to decrease CO₂? A possible explanation is the so-called Thermohaline Circulation, where the ocean is continuous and there's tidal flow, and this is the Mexican Gulf Stream. This stream comes from the hot areas and is a hot stream, and even people in Iceland can enjoy their lives. Although in the summertime it is only 14 degrees or so, in winter the temperature only drops to approximately 5 degrees below zero. Someone says that if the temperature increases more than 2 or 3 degrees, this tidal flow may stop. If something happens like this, there could be a sharp decrease in temperature like in the Younger Dryas Era 10,000 years ago. What happened at that time was during the course of increasing temperature after the ice age there was a sharp decrease in temperature. The glacier melted and there was a very big lake, then suddenly it collapsed and fresh water flowed into this region and stopped this Gulf Stream. That resulted in a very sharp decrease in the temperature. So that's why European countries are very careful about climate changes, and are so eager to reduce emissions of CO₂.

The global warming issue has been caused by the over consumption of oil, but the production of oil is, again, another problem. This is a graph describing the production and oil resources found during that time. This is 1945; this is 1980. It's true that we only have oil for 40 years or so. The reason is that if we produced some oil during a period, finding new resources of oil was usually successful. That means the amount of found oil was much larger than the amount consumed. But after 1980 the amount found decreased, so we entered a deletion mode. Usually, 40 years is the amount of reserves we have, so plus 40 means that 2020 is the key year for us to take a look at oil depletion.

However, the precise year doesn't mean anything at all if we draw this kind of figure. This is a 20,000-year graph with 10,000 years in both ways. This shows the era with all kinds of fossil fuels, so we only have the reserves of 300 or 500 years. If we take a look at this era, there's nothing at all. So even 500 years from now there's no fossil fuel left. We are now in the middle of this era, so it seems quite normal for us, but actually it's a very special occasion for humankind.

These are the transitions already achieved in Japan. We achieved to handle the destruction of forests, pollution issues, disasters and also landfill. The maximum landfill we experienced was in 1991. Now we are about to challenge CO₂ emissions and others. So this is

the trend in Japan.

I will skip the water issues, but I'd like to point out we are importing virtual water. Virtual water means the indirect import of water with food. So we are consuming this much water, and it's actually decreasing. But the amount of virtual water is increasing. We need much water if we want to supply food by ourselves.

These are the regions with water stress. These are some sequences of human activity: energy use, global warming, climate change, food/drought, crop production and famine. This is one sequence of human activity. But now we are trying to do something new - that's automobile. In order to reduce energy use and global warming, now we are trying to introduce ethanol for automobile use. If this happens, there's a possibility to increase a conflict between ways of using crops, for food or for energy.

Now let's move to the population issues. These are the projections by the UN, and we always have high, medium and low projections. Usually we say that we'll have a population of 9 billion in 2050, but I don't think it's true. I believe it will be less than the lower projection. Probably in 2040 a population of 7.7 billion will be the reality. We have to keep that value, and this is the current trend and future projection of the population. Japan will have a very sharp decrease in population. Italy, Korea and Ukraine already started a population decrease from the year of 1991 because of their economic collapse. The only problem is cases like that of Uganda. I believe their population is increasing because of poverty. They need manpower to gather wood from the forest for energy use or daily consumption, or gather water from remote rivers, etc. They need children for labour, so if we can eradicate extreme poverty, these key factors will decrease the population. It is historically proven, already. We have to increase our human activities below the sustainable capacity of the earth within 300 years, or so. The reason global warming is happening is that we are now doing human activities at a far greater level than the value of the sustainable capacity of the earth, owing to the consumption of fossil fuel. After consuming all fossil fuels we may have two scenarios. One is trying to continue to keep the quantity of human activity at the same level by using nuclear fission and nuclear fusion. Nuclear fission is not so dependable, so it's a little bit doubtful, but is a possible scenario. The other scenario is to reduce the population and also reduce the quantity of human activities below the level of sustainable capacity of the earth. If we depend on new technologies, maybe some uncertainties occur; some intentional distraction, mis-operation or human error. In addition to the population issues, our economic system must be changed within several decades. Efficiency improvement by 2015, renewable energy or corporate responsibility or habit of mind for value by people can be very important.

One example in Japan is a hybrid vehicle, which is very popular in the United States. This vehicle can reduce the emission of CO₂, almost by half. The energy efficiency already exceeded the so-called fuel-cell vehicle, and if we use gasoline, this is the answer, or better for only a few decades. After that, we need some change in the habits of minds.

Let's take a look at the life in Japan and in the world. This photograph was taken by a UN project in 1992 or '93. The UN asked the government to pick one typical family, and asked the family to bring all their furniture and belongings outside of the house. This is the case of Bhutan, and this is everything they own. There is some clothing and some others, but basically that's all. Bhutan is one of the poor countries, but the king, who has already

retired, said he didn't want to be evaluated by values such as GDP. They introduced the concept of GNH - gross national happiness. They said they must be evaluated by the amount of happiness.

If we take a look at the situation of Japan, we can see the house is full of furniture and everything, so Japan is a country to be evaluated by the amount of furniture and domestic appliances. The total number of things here is about 9,000. The equivalent number in Bhutan is about 25, so if they are happier than us, then what can we do?

Going back to the history of human beings, first we achieved the agricultural revolution in the Younger Dryas era about 10,000 years ago, then in the 1800s the industrial revolution. I believe we are about to have a 3rd revolution. That is to accept the depletion of fossil fuel, to reduce the amount of human activity within the carrying capacity of the earth, and to find out the true goals of human beings on this planet. So we can probably say we have to decrease everything, but pursue an increase in happiness. Also with economical activities in Japan, Japanese companies have reduced emission, resources and other things, and they are about to reduce sales. But still they can pursue profits for a while, but probably after the end of the 21st century they have to change their policy to reduce profits of their own, and redistribute to attain some happiness.

It's a very important time for us. We are now facing the depletion of fossil fuel and others, and we have to cope with global risks. I sincerely hope there is a very effective discussion concerning future sustainability. Thank you very much for your kind concentration.

—Prof. Kishinami—

Thank you very much, Dr. Yasui. Now the paper is open for discussion. Do you have any questions or comments?

—Questioner 1—

It is said, if you were about to depart from this world, one thing that you should never think is "I wish I had spent more time in the office, working". I think we have to appreciate more our total picture of life and what it is all about. So I think that's a very important issue.

—Prof. Itaru Yasui—

I'm almost the same age as you, probably, so I'm facing my retirement. So I think some contribution to the society is a very important point for everybody. Being isolated from our society is not such a happy situation, so just a good connection with society is very important. I agree.

—Questioner 2—

Thank you very much for this presentation. I think that if we have to reach these goals and the prospects of the 21st century, our advantage is that the people will not live 100 years to see whether our strategies functioned, or not. Do you think we need many more strategies or efforts? There is disorder now; you have mentioned this. I don't know whether these strategies could lead [to solutions] in the short term or medium term or long term. Poverty

is a big problem. You mentioned the two families from Japan and Bhutan. I know that in China and in India there are families that only possess 5 dollars and one blanket. The poverty problem is not only in developing countries, but also in Europe and the United States. According to the last figures in Germany, we have two million young people who belong in the world poverty scale. It is a big challenge; it is not only in the developing countries, but also in the industrialised countries. The gap between the poor and the rich in all countries is increasing.

—Prof. Itaru Yasui—

Thank you very much. I think it's an important point, and I have almost the same feeling as you. The solution is very difficult. I would say, as a person in the UN organisation, that the advanced countries should increase ODA. We have some pledges since 1970, and we repeated them several times. The last agreement was made in 2002 at the Johannesburg WSSS. Every advanced country should pay 0.7% of ODA to GDP. But now in Japan's case, we only pay 0.2% of ODA, and the United States pays 0.15%. For Germany it's also in the range of 0.2 or 0.3%. I think we have to increase the amount of ODA. Also we have to modify the economic system, or we have to change the habit of minds about the values of life of human beings. I think it's a very important point.

—Prof. Kishinami—

Thank you again, Dr. Yasui.

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Prospects of the 21st century
with respect to Sustainability

Itaru YASUI
United Nations University
<http://www.yasuienv.net/>

1

 UNITED NATIONS UNIVERSITY

Environmental Issues & Sustainable Development

UNU Mission & Roles

- "to contribute, through research and capacity building, to efforts to resolve the pressing global problems that are the concern of the United Nations, its Peoples and Member States"
- An international community of scholars
- A bridge between the United Nations and the international academic community
- A think-tank for the United Nations system
- A builder of capacities, particularly in developing countries
- A platform for innovative, creative ideas

4

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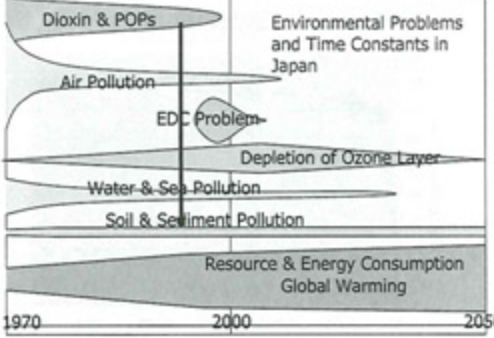
Experiences in Japan

- 1960s Minamata & Itai-Itai Diseases
- 1960s Amagasaki Traffic Pollution Issue
- 1970s POPs emission such as Dioxin and other Agrochemicals
- 1980s Illegal Dumping of Waste
- 1990s Waste Management, Recycling....
- 1997 Emission of CO₂ and GWG
- 1999 Endocrine Disrupting Compounds
- 2000- Sustainability Issues

3

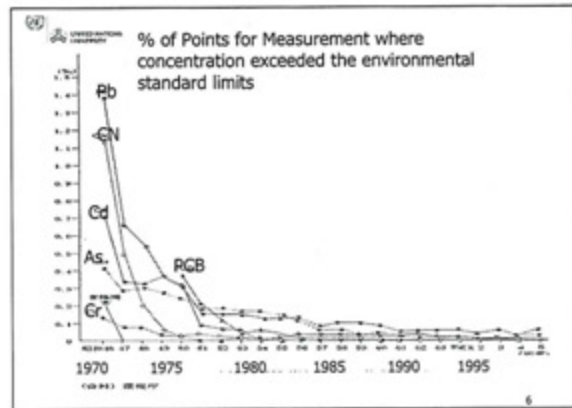
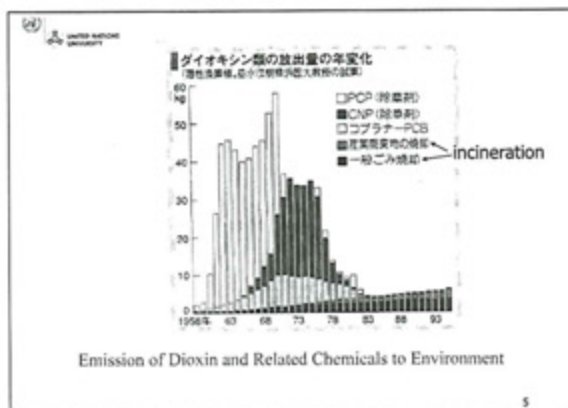
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Environmental Problems and Time Constants in Japan



1970 2000 2050

4



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What is Sustainable Development?

7

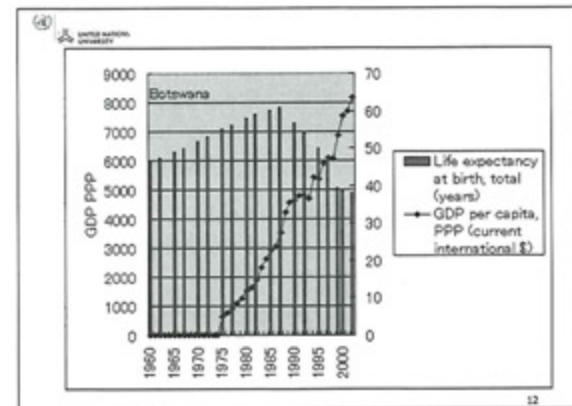
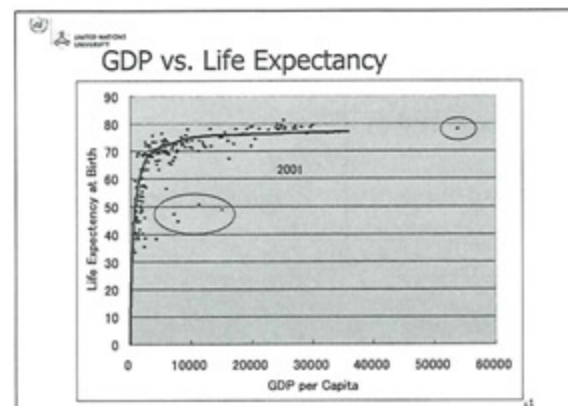
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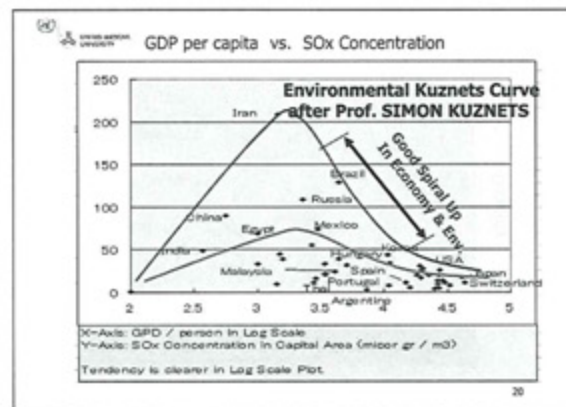
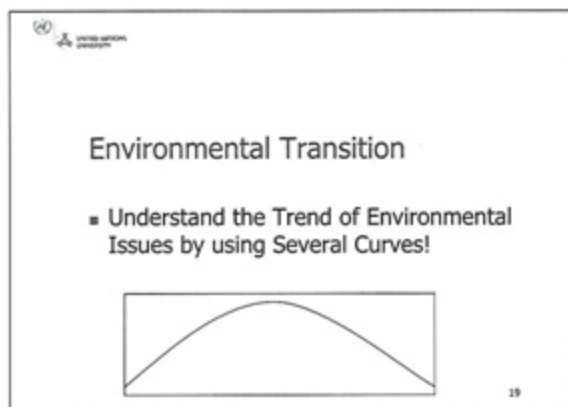
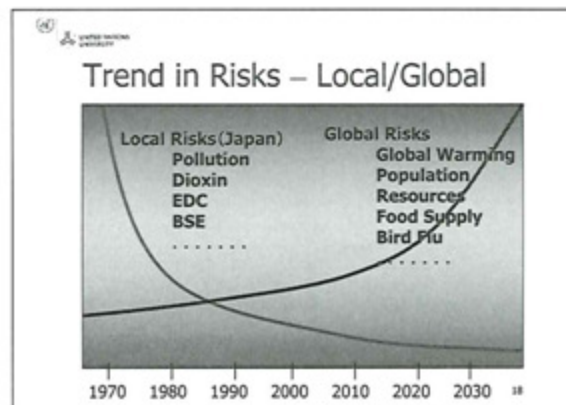
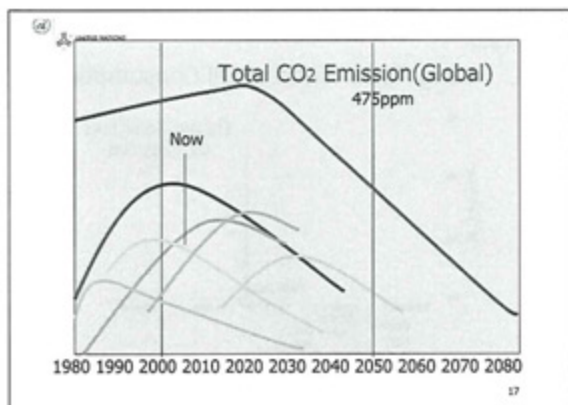
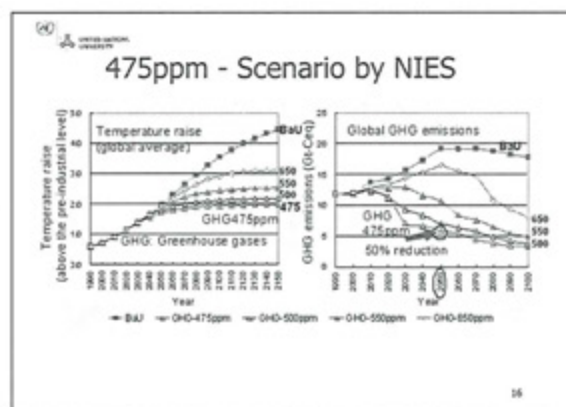
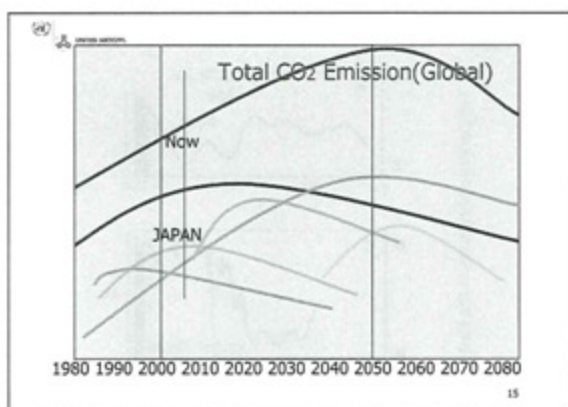
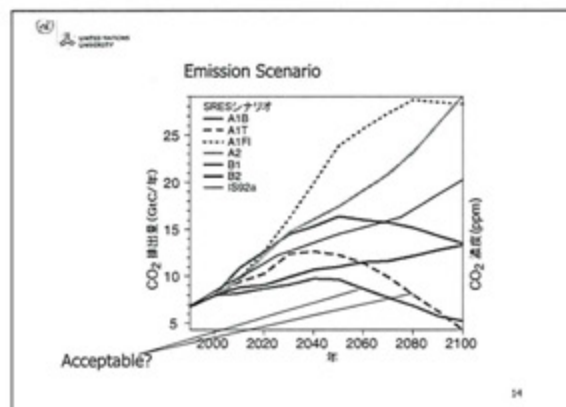
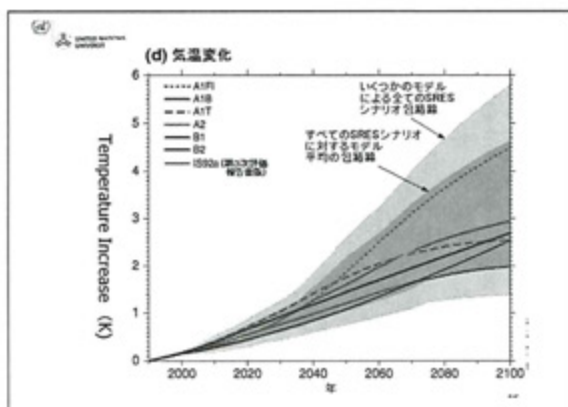
Millennium Development Goals

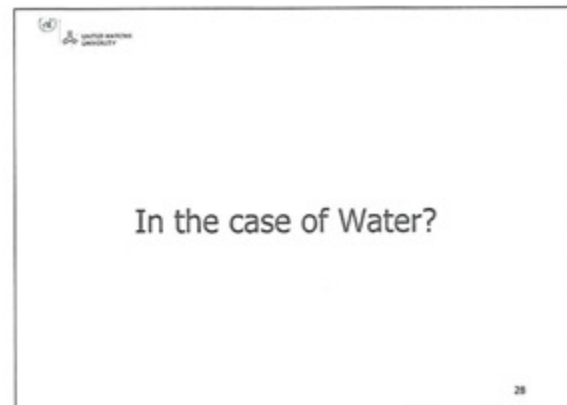
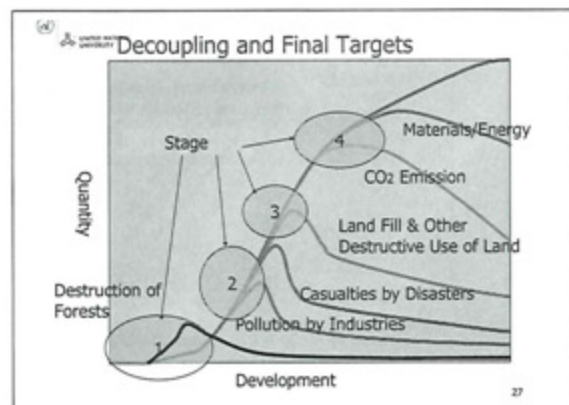
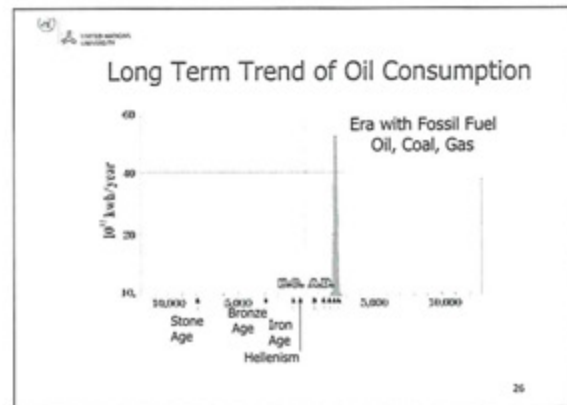
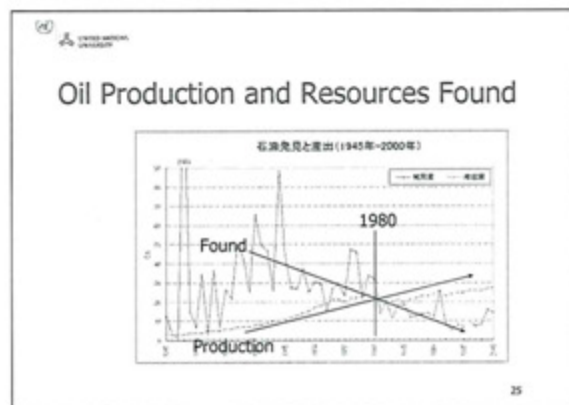
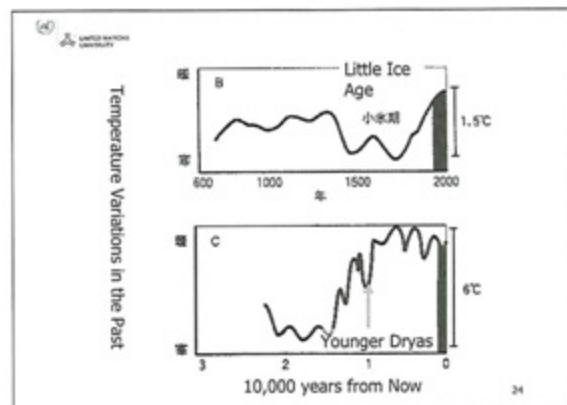
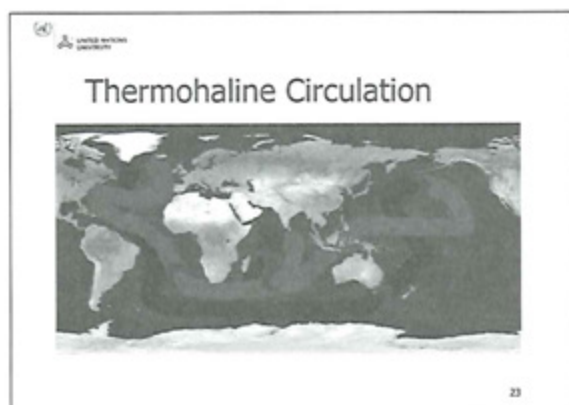
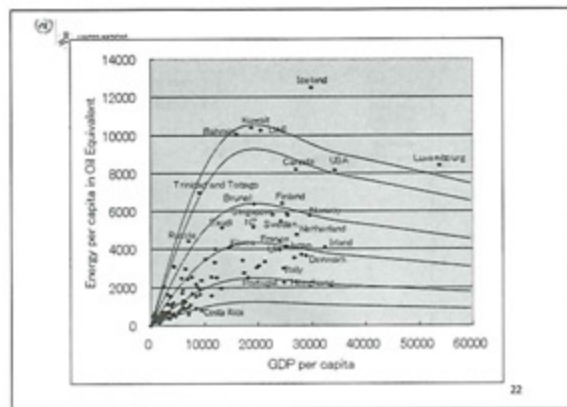
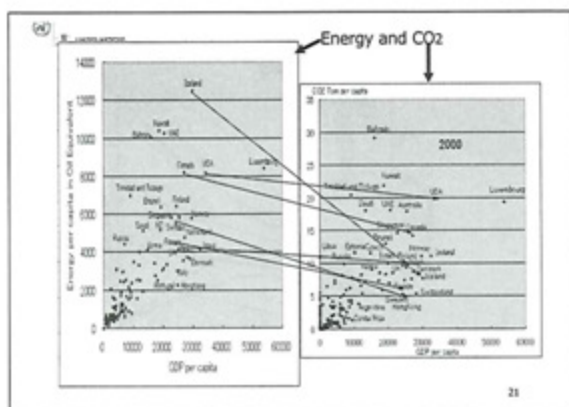
- The Millennium Development Goals are an ambitious agenda for reducing poverty and improving lives that world leaders agreed on at the Millennium Summit in September 2000. For each goal one or more targets have been set, most for 2015, using 1990 as a benchmark:

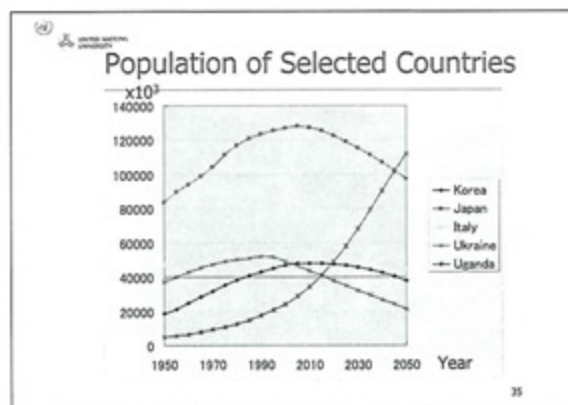
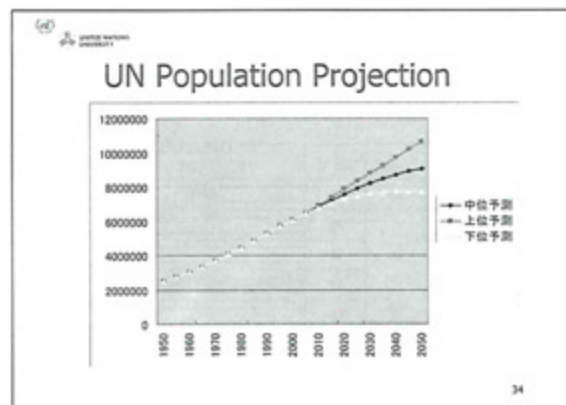
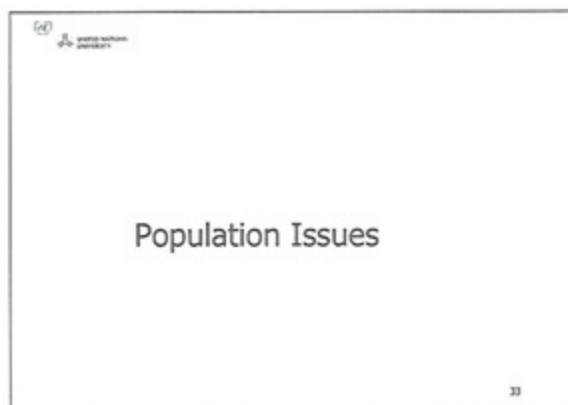
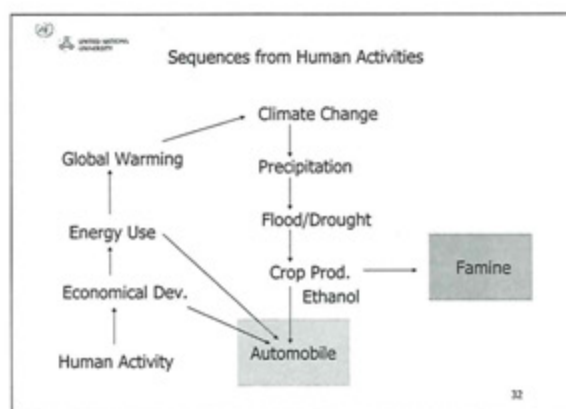
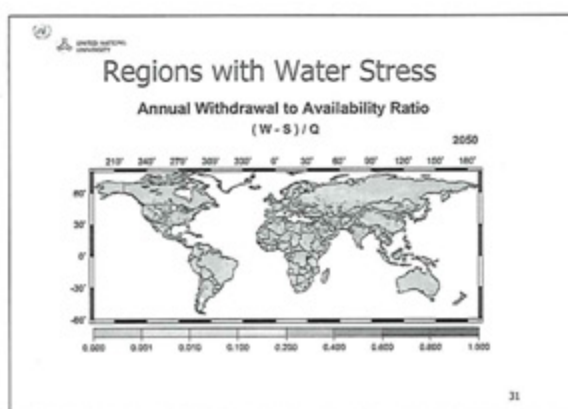
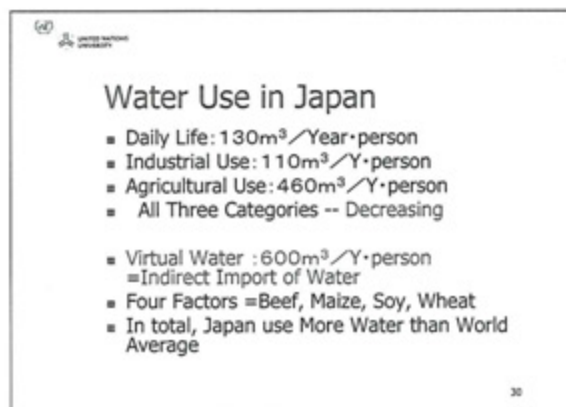
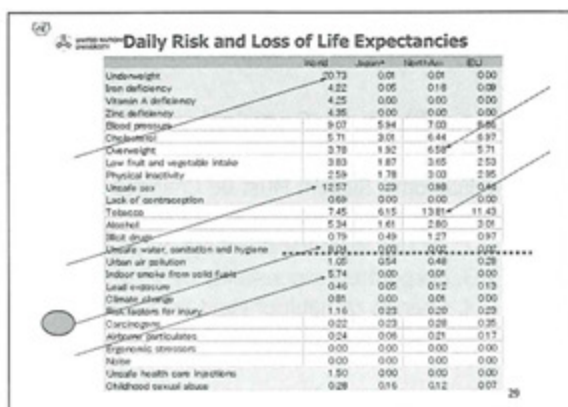
8

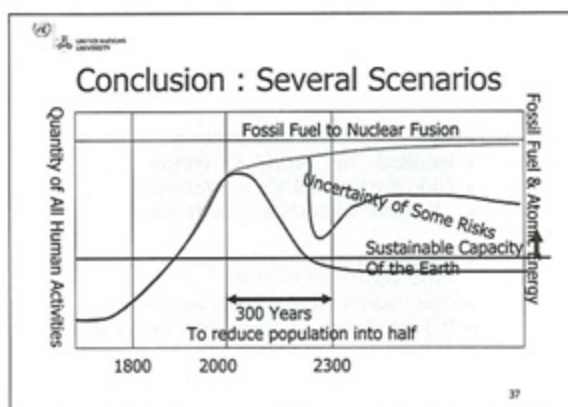
- ④ UNITED NATIONS UNIVERSITY
- 8 Goals in MDG
- 1. Eradicate extreme poverty and hunger
 - 2. Achieve universal primary education
 - 3. Promote gender equality and empower women
 - 4. Reduce child mortality
 - 5. Improve maternal health
 - 6. Combat HIV/AIDS, malaria and other diseases
 - 7. Ensure environmental sustainability
 - 8. Develop a global partnership for development
- 9











In addition to Population Issue

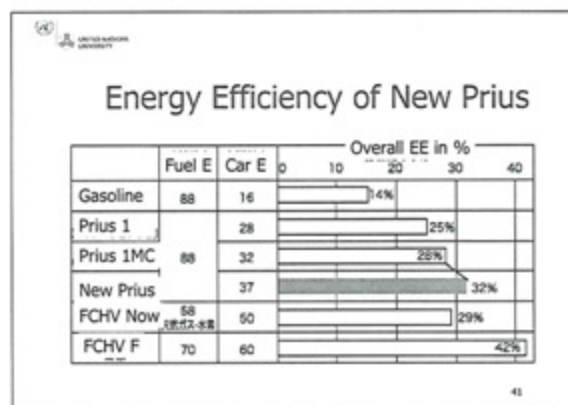
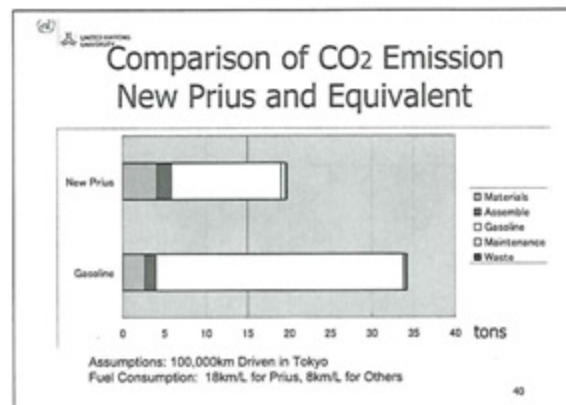
- Economic System Must Be Changed
- 1. Efficiency Improvement by 2015
- 2. To Use Renewable Energy by 2020
- 3. Corporate Responsibility by 2010
- 4. Change "A habit of Mind for Value" by 2030

38

**An Example
= New Prius**

■ Hybrid Motor Vehicle by TOYOTA

39



Life in Japan, Life in World

42

Bhutan 13 Family Members

188 US\$ 65m²

Radio 1

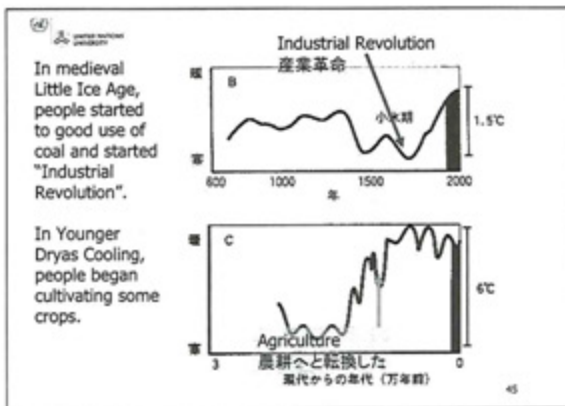
43

Japan 4 Family Members

32390 US\$ 128m²

Radio(3)
TV(1)
Telephone(1)
Car(1)
Bicycle(1)
PC(1)
Game Machine(1)
Electric Piano(1)
Fridge(1)
MW Oven(1)
Toaster(1)
Washer Dryer(1)
Rice Cooker(1)
Kotatsu(1)

44

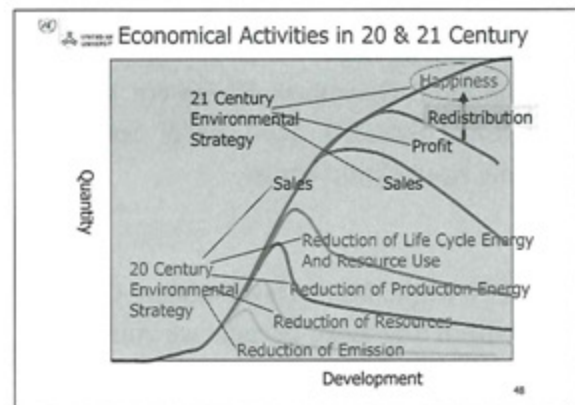
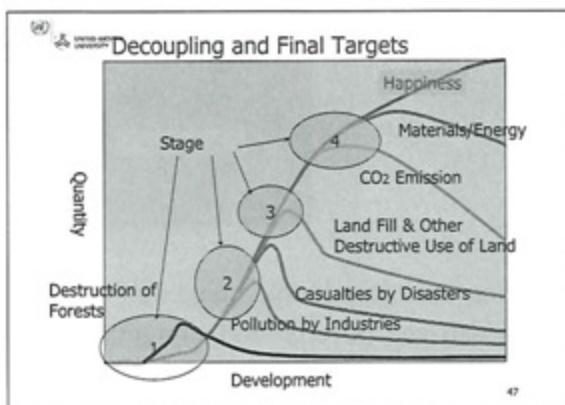


④⑤ 京都大学 環境学

The Third Revolution

- To Accept the Depletion of Fossil Fuel
- To Reduce the Amount of Human Activities within the Carrying Capacity of the Earth
- Possibly to Enhance the use of Nuclear Fusion, but it may be Risky
- To Find Out the True Goal of Human Beings on this Planet

46



Creating an Applied Earth System Science: Linking Global Environmental Change Science to Sustainability Issues

Kevin J. Noone

Executive Director

International Geosphere-Biosphere Programme (IGBP)

The Royal Swedish Academy of Sciences, Sweden

E-mail: zippy@igbp.kva.se



The UN Millennium Development Goals are an inspiring and formidable challenge for society: within the next decade we must aim to eradicate extreme poverty and hunger; achieve universal primary education; promote gender equality and empower women; reduce child mortality; improve maternal health; combat deadly diseases; ensure environmental sustainability; and construct a global partnership for development. At the same time, society is faced with other challenges such as global climate change, air pollution, decreases in global biodiversity, food resources and how all of these issues tie into global security.

Some have argued that it is not feasible to address all of these issues at once, and that we should simply use a sort of cost-benefit analysis to choose one on which to concentrate. This view may be appealing, but it is fundamentally misguided. It would be a tragedy if, for instance, we were able to completely eradicate HIV/AIDS only to discover that by ignoring global environmental change issues, malaria had become even more widespread or fresh water resources even more scarce. We do not have the luxury of solving these problems one at a time; they need to be tackled together. Understanding how the natural Earth System works, and how we humans influence (and are influenced by) it is at the very heart of addressing these issues, and achieving the Millennium Development Goals.

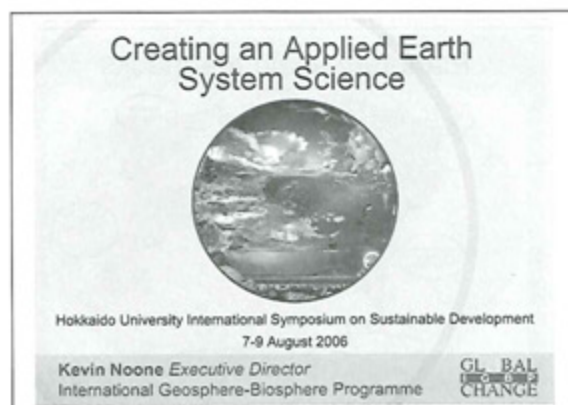
We now know that human activities now match (and often exceed) the natural forces that regulate the Earth System. Recent ice core data show that current levels of carbon dioxide and methane are well outside the range of natural variability over the last 800,000 years. Roughly half of the world's ice-free land surface has been altered by human actions. Humans now fix more nitrogen than nature does. Particles emitted by human activities alter the energy balance of the planet, as well as have adverse effects on human health. These may seem to be unrelated issues; however, over the last decades, we have gained a deeper

understanding of the degree to which all of these separate issues are linked. The Earth System is a very complex system with myriad feedbacks, and it has and presumably can still exhibit rapid, global-scale responses to changes in environmental conditions. The global change research community faces an increasing challenge to present research results in more accessible and informative ways to stakeholders - particularly those concerned with sustainable development. We are frequently expected to answer questions on the effects of global change on regional- and even local scales: stakeholders seek strategies to deal with future environmental change.



The need to understand how the natural world works has not diminished, but in fact underpins the answers to questions of sustainable development. We still must concentrate on first class science involving the interactions and feedbacks between biological, chemical and physical processes and human systems. However, scientists, resource managers and policy makers require a common understanding in order for their interactions to be mutually beneficial.

In my presentation, I will attempt to give an overview of the current landscape of Earth System Science, give an example (or two) of planetary-scale feedback systems that may impact sustainable development strategies, discuss some the current structural challenges we have in addressing the interdisciplinary questions with which we are faced, and provide some ideas for creating an *Applied Earth System Science* linking global environmental change research to sustainable development.



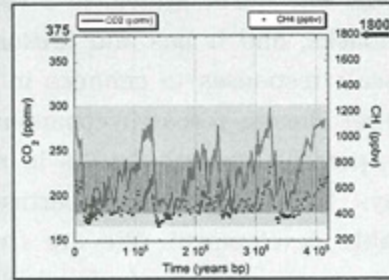
Outline

- A view from the distant past
- The human imprint
- Examples of systemic questions - feedbacks, teleconnections & abrupt changes
- Regional development and global consequences
- Research approaches for the Earth System
- Linking Global Environmental Change Science to Sustainability Issues



GL BAL
UNCOMMON
CHANGE

Vostok ice core: 400,000 years



Source: Petit, et al., Nature 399, 429-436, 1999

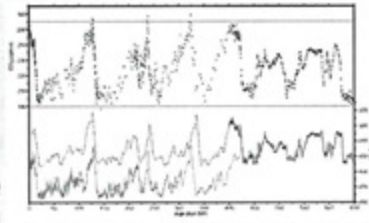
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CHANGE

Even farther back in time...

A temperature and CO₂ record 650 000 years back in time



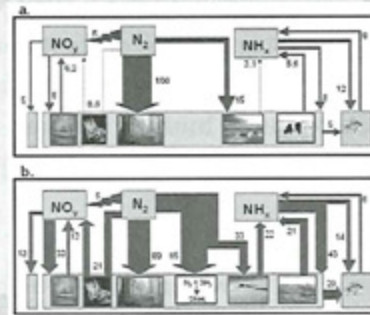
Dome C



Siegenthaler, et al., Science 310, 25 Nov. 2005

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UNCOMMON
CHANGE

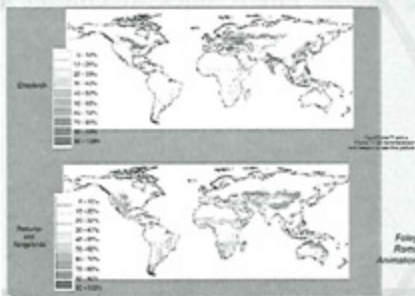
Global nitrogen budget



Galloway & Cowling, Ambio 31 (2), 2002

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CHANGE

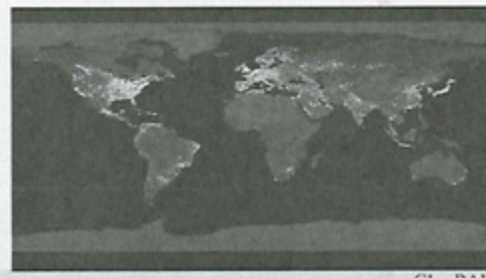
Global agricultural land use



Foley et al., Science, 2005
Rötter et al., 1999
Ammonium form

GL BAL
UNCOMMON
CHANGE

Human influence seen from space



http://visibleearth.nasa.gov/images/1436/earth_lights.jpg

GL BAL
UNCOMMON
CHANGE

Planetary-scale feedbacks



J. Scheffhuber, in Steffen, et al.,
Challenges of a Changing Earth, 2002

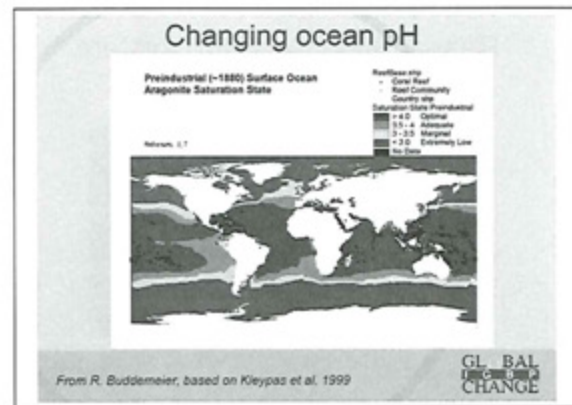
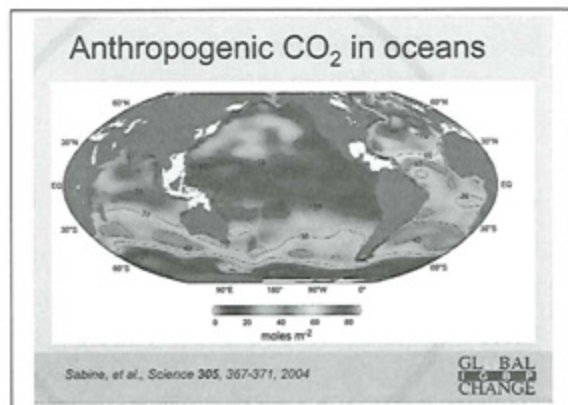
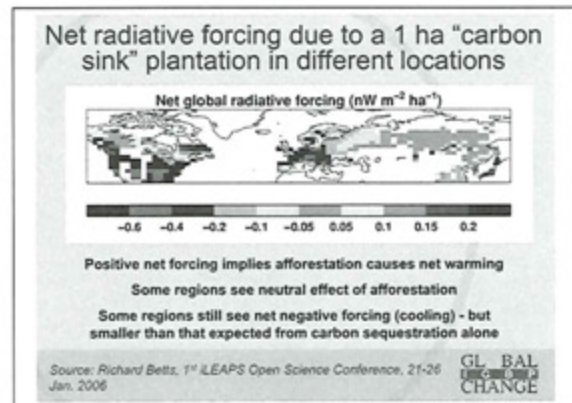
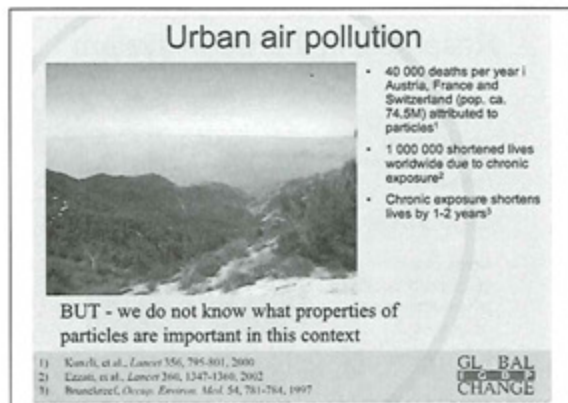
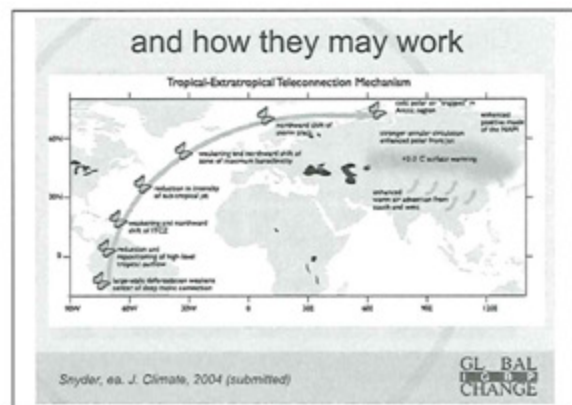
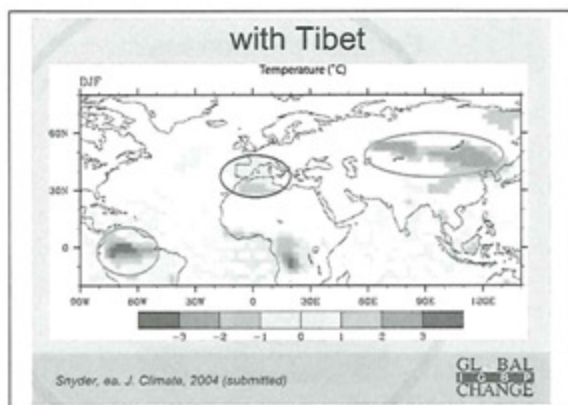
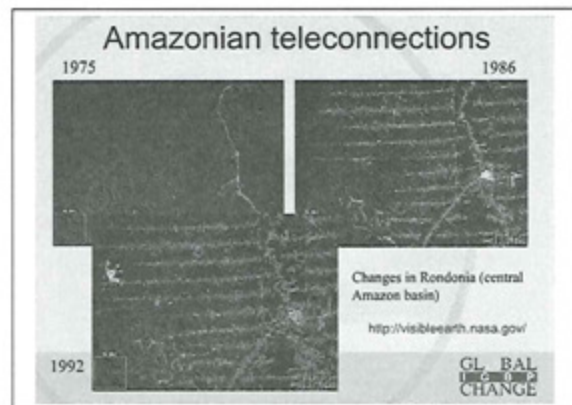
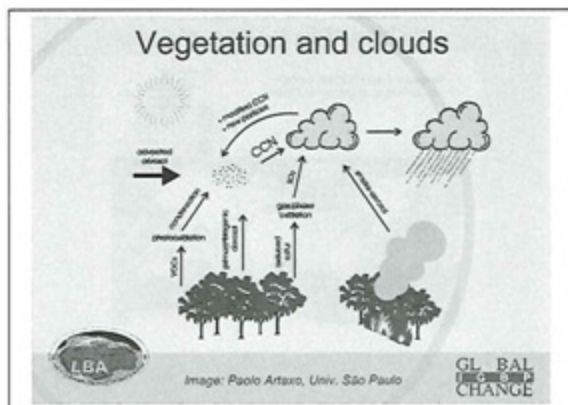
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Examples of planetary-scale feedbacks

- Aerosol-cloud-climate interactions
- The Amazon and global teleconnections
- Changing ocean pH
- Iron fertilization of the oceans



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CHANGE

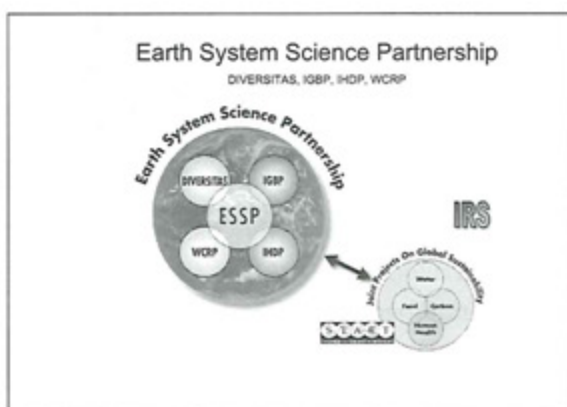




Earth System Science Partnership

DIVERSITAS, IGBP, IHDP, WCRP

- an integrated study of the Earth System,
- the changes occurring to the System, and
- the implications for global sustainability.



Dialogue?

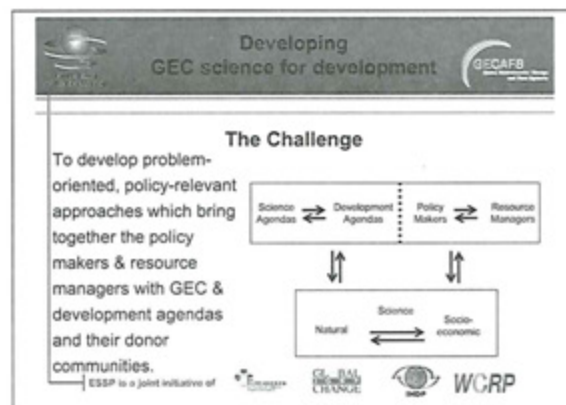
Development/Aid

You [GEC] scientists should stop being computer nerds and tell us what we should do!

GEC Research

Do you really want a computer nerd telling you what to do?

IGFA/ICSU Meeting - The Interface Between Global Change and Development-Oriented Research, 17-19 May, 2005, Sweden



One way forward

- An Earth System Science Institute
- Gather natural & social scientists, economists, engineers in a long-term framework
- Look at regional/global feedbacks
- Involve stakeholders

GL BAL

Thank you for your attention!

GL BAL

Glacial Inceptions: Past and Future

Lawrence A. Mysak

Professor
Department of Atmospheric and Oceanic Sciences
McGill University, Canada
E-mail: lawrence.mysak@mcgill.ca



Determining the causes and mechanisms of glacial inceptions during the past half million years has challenged scores of climate theoreticians and modellers. After introducing the basic Milankovitch theory of glaciation, I will review a number of earlier modelling studies on past glacial inceptions which have employed high-resolution GCMs or EMICs: Earth system Models of Intermediate Complexity. The latter class of climate models has been developed over the past two decades in order to investigate the many interactions and feedbacks among the geophysical and biospheric components of the Earth system over long time-scales.

Following an overview of various EMICs from Europe and North America, including the McGill Paleoclimate Model (MPM), I will present some recent simulations of the last glacial inception (LGI) in response to orbital (Milankovitch) and radiative (atmospheric CO₂) forcing. Special attention will be given to determining the relative roles of the ocean thermohaline circulation, freshwater fluxes, orography, cryospheric processes and vegetation dynamics during the inception phase.

The lecture will conclude with a discussion on the (possible) occurrence of the next glacial period. To address this issue, which has been inspired by recent Berger-Loutre papers with titles like "An exceptionally long interglacial ahead?", I shall present EMIC simulations of the climate for the next 100 kyr which are forced by a various prescribed atmospheric CO₂ levels, as well as insolation changes. The influence of a near-term global warming scenario on glacial inception will also be examined.



Finally, the recent simulations of glacial inceptions in the Potsdam (PIK) EMIC which includes an interactive carbon cycle will be described. It is not inconceivable that due to human activities, the current interglacial will last for at least another half million years.

Glacial Inceptions: Past and Future

Lawrence A. Mysak

with Z. Wang, A.-S. Cochelin and Y. Wang

Atmospheric & Oceanic Sciences,
McGill University, Montreal, Canada

McGill www.esmg.mcgill.ca C²GCR → GEC3 (2004)



Recent Collaborators:

- A. Berger, H. Blatter, V. Brovkin,
- M. Claussen, A. Ganopolski, O. Marchal,
- J. McManus, V. Petoukhov, S. Rahmstorf



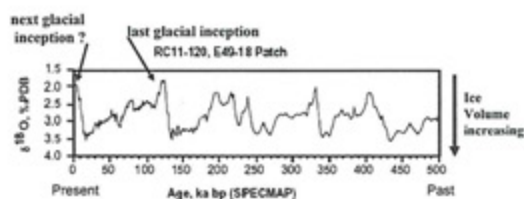
- Others at McGill: A. Antico, A. Jahn, J.-F. Lemieux, B. Papa, N. Roulet, J. Sedláček, G. Smith, K. Wright

McGill

Outline

1. Introduction
2. On the theory of glacial inceptions
3. Modelling work on the last glacial inception
4. The McGill Paleoclimate Model (MPM): an EMIC
5. Simulation of the last glacial inception with the MPM
6. On the (possible) occurrence of the next glacial
7. Conclusions

1. Introduction



- Glacial periods occur naturally due to a complex set of interactions involving external forcing and internal processes.

... Some questions

- How did the last glacial start?
- When will the present interglacial end?
- What will the climate be like in the next 100 kyr?
- Will mankind's activities affect the occurrence of the next glacial?



EMICs with Milankovitch forcing (and prescribed CO₂): transient runs:

Without vegetation:

- Loutre and Berger (2000, Clim. Change)
 - Simulated the last two glacial cycles with the 2-D LLN model
- Wang and Mysak (2002, GRL)
 - Used the 5-component geophysical MPM
 - Showed that THC intensity increased during ice sheet growth; however, ice sheet volumes over N. Amer. and Eurasia were similar

With vegetation:

- Gallée et al. (1992, JGR)
 - First to show vegetation important
- Crucifix and Loutre (2002, Clim. Dyn.)
 - Simulated a large southward treeline shift in high northern latitudes; this was necessary for the appearance of perennial snow cover

2. On the theory of glacial inceptions

The natural evolution of the climate

The primary driver of ice ages is the summer solar radiation received in high northern latitudes (Milankovitch 1930, 1941).

This insolation depends on the variations of 3 orbital parameters of the Earth's motion about the Sun:

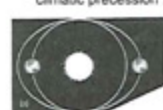
- the eccentricity, e
- the obliquity
- the precession of the equinoxes



1879-1958

The Orbital Parameters

- The eccentricity, e measures the ellipticity of the orbit of the Earth around the Sun.
- The obliquity measures the inclination of the Earth's rotation axis, perpendicular to the plan of the ellipse.
- The precession of the equinoxes, which is due to the Earth's wobble (c), and the precession of the earth's elliptical orbit (shift of the perihelion). The combined movement has a strong cycle near 23 kyr. However, this cycle is modulated by the eccentricity, resulting in a quantity called the "climatic precession".



$T = 400 \text{ kyr and } 100 \text{ kyr}$



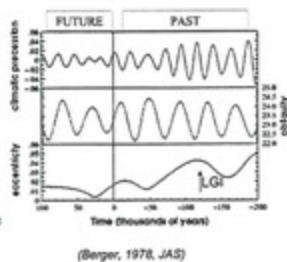
$T = 41 \text{ kyr}$



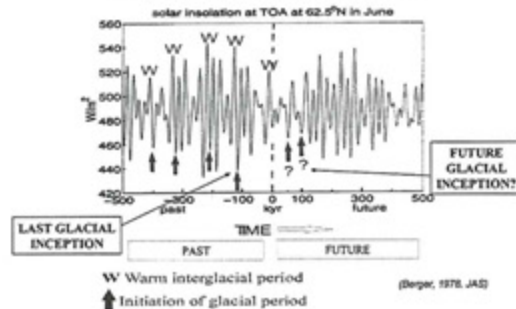
$T = 25.7 \text{ kyr}$

The Milankovitch theory of glacial inception

- At the last glacial inception (~116 kyr BP), the climatic precession (a measure of the Earth-Sun distance at the summer solstice) and eccentricity were high and the obliquity was low.
- These factors led to a very low summer insolation at high northern latitudes (see next figure).

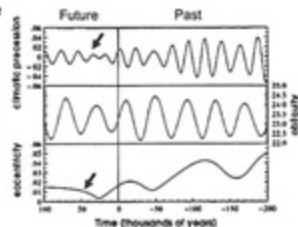


The natural evolution of climate



The Next Glacial Inception

- During the next 100 kyr, the climatic precession and eccentricity will have only weak variations.
- This results in relatively small variations of summer insolation at higher northern latitudes.

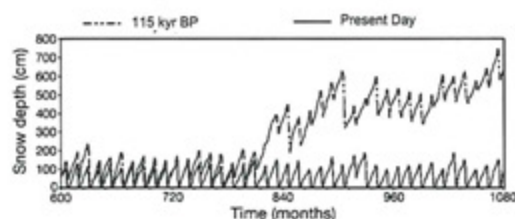


3. Modelling work on the last glacial inception

AGCMs with Milankovitch forcing (and prescribed atmospheric CO₂); time-slice runs:

- de Noblet et al. (1996, GRL)
- Gallimore and Kutzbach (1996, Nature)
- Pollard and Thompson (1997, Ann. Glaciol.)
- Khodri et al. (2001, Nature) (with OGCM)
 - Showed that the THC could be important
- Yoshimori et al. (2002, Clim. Dyn.)
 - Examined the role of SST and sea-ice cover
- Kubatzki et al. (2006, Clim. Dyn.)
 - Examined the sensitivity of inception to size of Greenland ice sheet
- Vettoretti and Peltier (2004, Quat. Sci. Rev.)
 - Did transient runs with an AGCM coupled to a mixed layer ocean to investigate the relative roles of the orbital parameters: obliquity dominates

High-latitude (70° N, 80° W) snow accumulation at 115 kyr BP in coupled A-O GCM over a 40-year period (Khodri et al., 2001)



EMICs with Milankovitch forcing (and prescribed CO₂); transient runs:

Without vegetation:

- Loutre and Berger (2000, Clim. Change)
 - Simulated the last two glacial cycles with the 2-D LLN model
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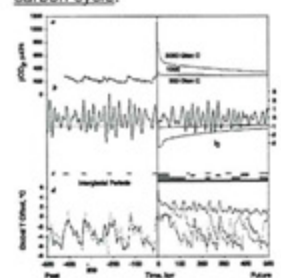
EMIC transient runs with vegetation continued:

- Kageyama et al. (2004, GRL)
 - The inclusion of vegetation produced a large ice sheet over N. America; however, Eurasia was ice free.
- Calov et al. (2005a, 2005b, Clim. Dyn.)
 - Found that the ice-albedo feedback was dominate for ice sheet growth; vegetation played a secondary role.
- Wang et al. (2005, GRL)
 - With vegetation, the resulting ice sheet volume over N. America was larger than that over Eurasia.

Notes:

- An important time-slice investigation which looked at the role of vegetation on temperature and sea-ice cover:
 - Meissner et al. (2003, Clim. Dyn.)
- In all the above references, the atmospheric CO₂ was prescribed.

Archer and Ganopolski (2005, G³): Simulation of past and future (?) glacials using an EMIC with an interactive carbon cycle.



- Anthropogenic releases of 300, 1000 and 5000 GtC are indicated by blue, orange, and red lines resp. in panel a. (5000 GtC is the total amount of coal available.)
- The impacts of the above carbon releases on glacial inception and global temperature are shown in panels c and d.

4. The McGill Paleoclimate Model (MPM): an EMIC

- Ref: Claussen et al. (2002, Clim. Dyn.):
Earth system models of intermediate complexity: closing the gap in the spectrum of climate system models
 - A new perspective on the hierarchy of climate models is proposed.
 - Most notably, we introduce a new indicator, called "integration", which characterizes the number of interacting components of the climate system in the model.
 - The location of several model types, from conceptual to comprehensive, is presented in a new spectrum of climate system models.

The Natural Earth System

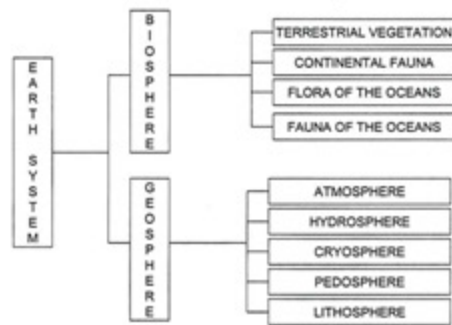
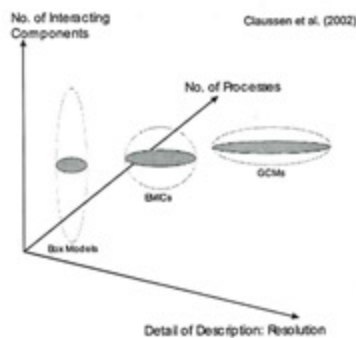


Table of EMICs (Claussen et al., 2002)

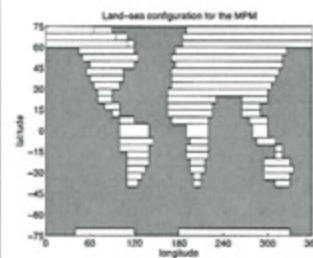
No.	Model	Institution
1	Bern 2.5D	University of Bern, Switzerland
2	CUMBER-2	Potsdam Institute for Climate Impact Research, Germany
3	Ecdit	Royal Netherlands Meteorological Institute, Netherlands
4	Ecdit-Clo	ASTR-UCL, Belgium
5	IAP RAS	Inst. Atmos. Phys., Russia
6	MPM	McGill University, Canada
7	MIT	MIT, USA
8	MobidC	ASTR-UCL, Belgium
9	PUMA	Max-Planck-Institute for Meteorology, Germany
10	UVic	University of Victoria, Canada
11	IMAGE 2	U. of Kassel, Germany

Interactive components of the climate system being implemented into EMICs (Claussen et al., 2002)

Model	Atmos.	Ocean	Biosph.	Sea ice	Land ice
1	1D/2D, 1-2D/3D	2D/3D, 1D/2D	1D/2D	1D	1D
2	1D/2D, 1-2D/3D	2D/3D, 1D/2D	1D/2D	1D	1D
3	1D/2D, 1-2D/3D	2D/3D, 1D/2D	1D/2D	1D	1D
4	1D/2D, 1-2D/3D	2D/3D, 1D/2D	1D/2D	1D	1D
5	1D/2D, 1-2D/3D	2D/3D, 1D/2D	1D/2D	1D	1D
6	1D/2D, 1-2D/3D	2D/3D, 1D/2D	1D/2D	1D	1D
7	1D/2D, 1-2D/3D	2D/3D, 1D/2D	1D/2D	1D	1D
8	1D/2D, 1-2D/3D	2D/3D, 1D/2D	1D/2D	1D	1D
9	1D/2D, 1-2D/3D	2D/3D, 1D/2D	1D/2D	1D	1D
10	1D/2D, 1-2D/3D	2D/3D, 1D/2D	1D/2D	1D	1D
11	1D/2D, 1-2D/3D	2D/3D, 1D/2D	1D/2D	1D	1D



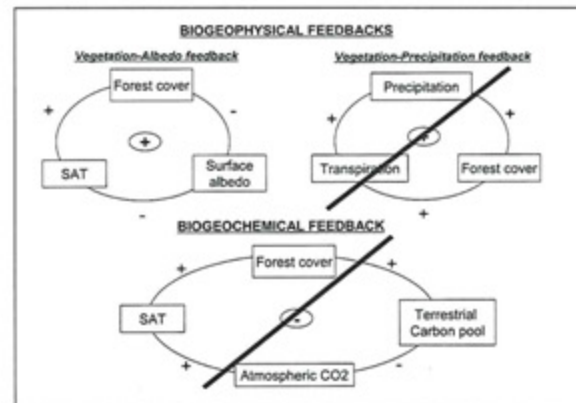
Land-Sea configuration in the MPM (Wang and Mysak, 2000)



- Model variables in each latitude band are sectorially averaged in zonal direction across each continent and ocean basin.
- However, downscaling for the atmospheric variables is used north of 30° to obtain 2-D distributions of vegetation cover and ice sheets in this region (Wang and Mysak, 2002).

Components of the "green" MPM

- Atmosphere:** a sectorially averaged energy-moisture balance model based on Fanning and Weaver (1996, JGR) with modified heat and moisture transports.
- Ocean:** a zonally averaged 2-D ocean model from Wright and Stocker (1991, JPO).
- Sea ice:** a zero-layer thermodynamic model based on Semtner (1976, JPO) and Hibler (1979, JPO), but with prescribed advection in NH.
- Ice sheet:** a 2-D vertically integrated dynamic isothermal ice sheet model (Marshall and Clarke, 1997, JGR), with a latitude-longitude resolution of 0.5° x 0.5°.
- Land surface:** an energy budget and bucket model based on Ledley (1988, JGR) and Manabe (1969, MWR). Updated with Biosphere - Atmosphere Transfer Scheme (BATS) (Dickinson et al., 1986, NCAR; Y. Wang et al., 2005, Clim. Dyn.).
- Vegetation:** VECODE model from Brovkin et al. (1997, Ecol. Mod.), modified by Y. Wang et al. (2005, Clim. Dyn.). Vegetation is grass or trees (evergreen or deciduous).
e.g., Snow free albedo: $\alpha_{\text{tree}} = f_{\text{veg}} \alpha_{\text{veg}} + f_{\text{desert}} \alpha_{\text{desert}}$
trees grass desert



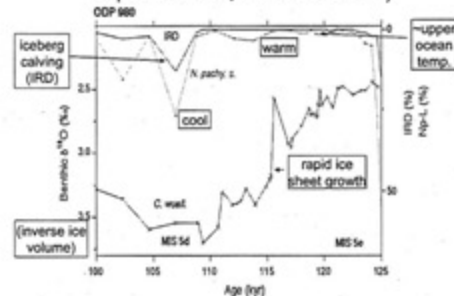
5. Simulation of the last glacial inception with the MPM

- Without vegetation: Wang and Mysak (2002, GRL)
- With vegetation: Wang et al. (2005, GRL)
 - Application of the "green" MPM

Paleoceanographic data reveal:

- Subpolar N. Atlantic was warm during the initial phase of the LGI, around 120 kyr BP (Ruddiman and McIntyre, 1979, Science).
- Rapid ice sheet growth occurred during the next 10 kyr and the sea level dropped over 50 m (Johnson and Andrews, 1979, Quat. Res.)

ODP SITE 980 (55°29'N, 14°42'W, depth: 2179 m; N.E. N. Atlantic)

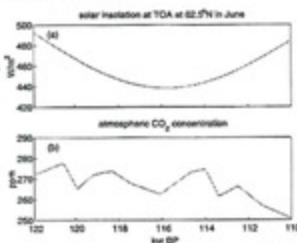


Jerry McManus, pers. comm. (2002)

External forcing used in the geophysical MPM

(Wang and Mysak, 2002)

- Variable solar insolation calculated by realistic orbital parameter changes (Berger, 1978).
- Vostok atmospheric CO₂ concentration (Barnola et al., 1999).
- The model is integrated from 122 to 110 kyr BP.



Experimental Design

Run	Coupling	CO ₂	Mountain	Freezing/Refreezing
1. Control run	Fully coupled	Vostok	yes	yes
2. Fixed freshwater flux (into the ocean)	P-E+R prescribed	Vostok	yes	yes
3. Fixed ocean	SST prescribed	Vostok	yes	yes
4. No mountain	Fully coupled	Vostok	no	yes
5. No freezing/refreezing	Fully coupled	Vostok	yes	no
6. No mountain and no freezing/refreezing	Fully coupled	Vostok	no	no
7. Milankovitch only	SST prescribed	280 ppm	no	no

Ice sheet growth in the geophysical MPM

- Run 1 (control run – in red) produces the most rapid ice sheet growth.
- Run 7 (only Milankovitch forcing – in black) produces the smallest ice volume.
- For a rapid ice sheet growth, the elevation effect of mountains, freezing of rain and refreezing of meltwater, and an active ocean component are necessary.

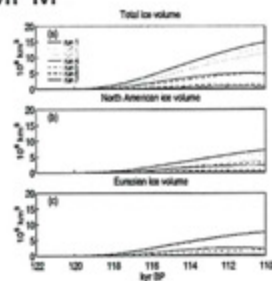


Figure 2. Simulated ice volume growths.

THC response and its effect on ice sheet growth

- The THC is significantly intensified for run 1 (in red) due to the high latitude cooling and reduced freshwater flux.
- The strong THC maintains a large land-sea thermal contrast at high latitudes and hence is favorable for rapid ice sheet growth due to moisture transport from the ocean to the land.

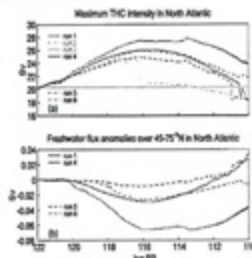


Figure 3. The maximum THC intensities and freshwater flux anomalies.

Ice sheet thickness over N. America and Eurasia in the geophysical MPM

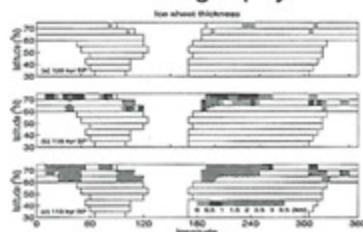
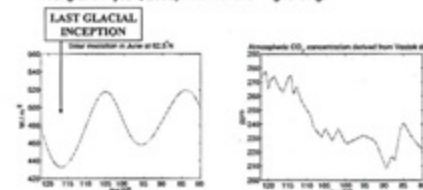


Figure 4. Ice sheet thickness over North America and Eurasia for run 1 (control run) at 120 kyr BP (a), 116 kyr BP (b), and 110 kyr BP (c).

Simulation of glacial inception in the "green" MPM

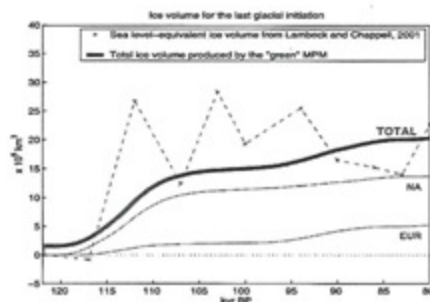
(Cochelin, 2004, MSc thesis; Wang et al., 2005, GRL)

- The model is run from 122 to 80 kyr BP (versus a 12 kyr run in Wang and Mysak, 2002) with the following forcing:

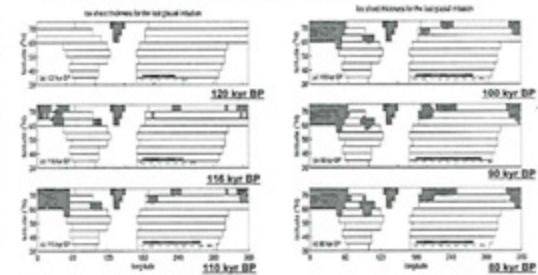


- We want to observe the changes in the climate simulation, due to the addition of the vegetation.

Ice sheet growth in the "green" MPM



Ice sheet distributions obtained with the "green" MPM at 120, 116, 110, 100, 90 and 80 kyr BP



Northern tree and desert fractions in the "green" MPM

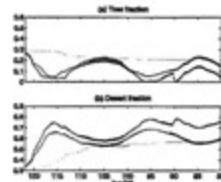
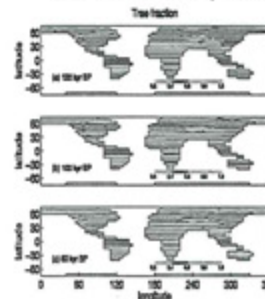


Figure 3. (a) Tree fraction in land (including ice sheets) and (b) desert fraction in land (including ice sheets), averaged between 60 and 75°N, for the control experiment (red), the experiment with fixed S&T (green) and the experiment with fixed precipitation (blue) in the vegetation component.

- Note that in the control run (in red), the tree fraction closely follows the summer insolation variation, showing the climatic precession signal (23 kyr). However, the desert fraction has the opposite behaviour.
- The similarity of the red (control) and blue (fixed precip.) curves in panel (a) indicates that temperature predominantly drives vegetation in high northern latitudes.

Tree fraction distribution in the "green" MPM at 122, 100 and 80 kyr BP



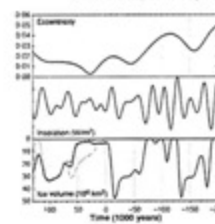
- As the ice sheets build up, the trees progressively disappear and give way to desert in the high northern latitudes.
- In the high northern latitudes, the treeline has shifted southward by 5° to 10° lat.
- The changes in vegetation and the associated changes in surface albedo contribute to the expansion of the ice sheets, owing to the positive vegetation-albedo and ice-albedo feedbacks.

Conclusions from the simulation of the last glacial inception in the "green" MPM

- Under realistic external forcings, the "green" MPM simulates the last glacial inception at ~ 119 kyr BP.
- The glacial inception is followed by a rapid ice sheet growth over North America and a slower growth over Eurasia. This contrasts with the results of Wang and Mysak (2002, GRL) who found comparable growths over North America and Eurasia.
- The volume of ice simulated is too low until 90 kyr BP, but it finally reaches the estimated observed value around 80 kyr BP.
- As the ice sheets develop, we observe a southward shift of the treeline and an expansion of the desert at high latitudes.

6. On the (possible) occurrence of the next glacial

- Loutre and Berger (2000, Clim. Change)
- Berger and Loutre (2002, Science): "An Exceptionally Long Interglacial Ahead?"

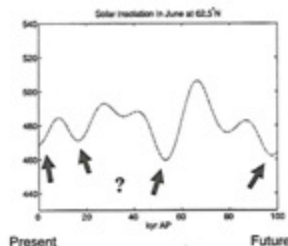


Long-term variations of eccentricity (top), June insolation at 65° N (middle), and simulated Northern Hemisphere ice volume (increasing downward) (bottom) for 200,000 years before the present to 130,000 from now using the 2-D LLN EMIC.

— Vostok CO₂
--- Global Warming CO₂
— Constant CO₂ (210 ppmv)

Cochelin et al. (2006, Clim. Change): Simulation of the next glacial inception.

- The "green" MPM is run for the next 100 kyr, with different atmospheric CO₂ levels and Milankovitch forcing.

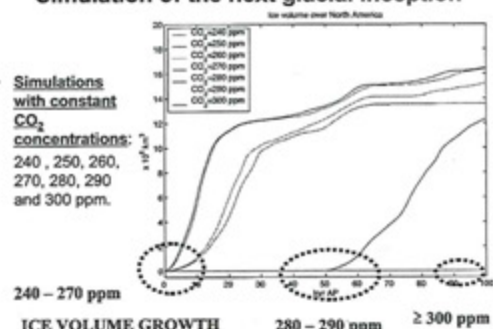


Solar insolation in June, at 62.5° N

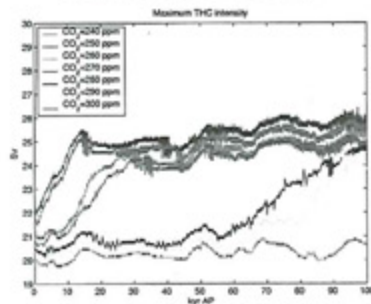
When will the next glaciation occur?

Simulation of the next glacial inception

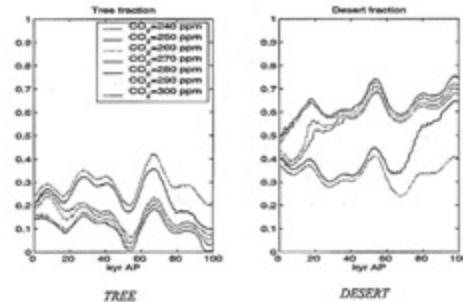
- Simulations with constant CO₂ concentrations: 240, 250, 260, 270, 280, 290 and 300 ppm.



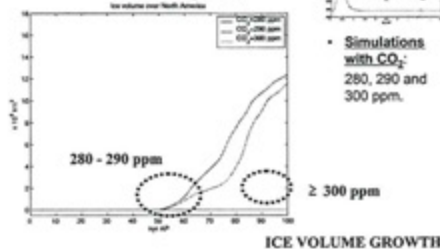
Simulation of the THC behaviour for the next 100 kyr



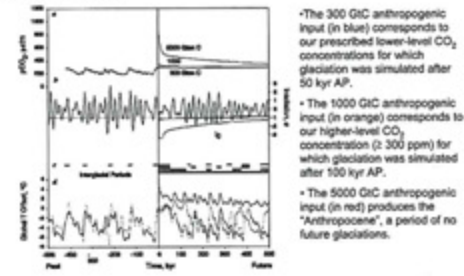
Tree and desert fractions at high latitudes for the next 100 kyr



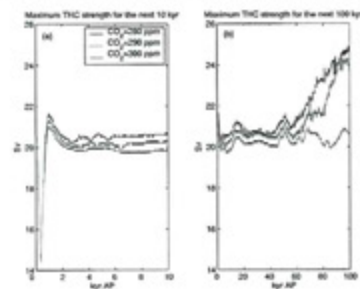
Simulation of the next glacial inception when a WARMING EPISODE is included during the first 1200 years.



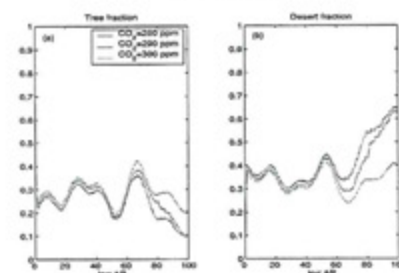
Archer and Ganopolski (2005, G³): Simulation of past and future (?) glacials using an EMIC with an interactive carbon cycle.



Simulated THC behaviour when an initial global warming episode is included



Tree and desert fractions at high latitudes, when an initial global warming episode is included



7. Conclusions

- To investigate long-term climate changes involving interactions among all the climate components, EMICs can play a useful role.
- In particular, EMICs can be used to address certain questions that are normally outside the utility of higher resolution GCMs.

7. Conclusions cont.

- For the next 100 kyr, under "natural" climate forcing,
 - The next glacial inception occurs in the "green" MPM at around 50 kyr AP if atmos. CO₂ lies between 280 and 290 ppm;
 - For a lower CO₂ level, glacial inception is imminent;
 - For a higher CO₂ level, no inception will occur during the next 100 kyr.
- If a global warming episode is included and the atmospheric CO₂ level asymptotes to a constant value after 5 kyr, cases 1. and 3. still apply.

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Ecological Constraints on System Sustainability*

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Professor

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E-mail: kohyama@ees.hokudai.ac.jp



The anthropogenic biosphere is a complex adaptive system, constrained by a variety of processes, of which typical spatial-temporal scale is different from each other. In this lecture, I show the need of multi-scale analysis of system change, taking an example of forest ecosystems. I also propose that a similar approach is valid for socio-environmental systems.

We carried out a synthetic investigation of forest ecosystems in eastern Monsoon Asia. The target area is characterized by the continuous forested biomes from tropic to subarctic zones under prevailing humid climate. We made challenge to link physiological processes of foliage

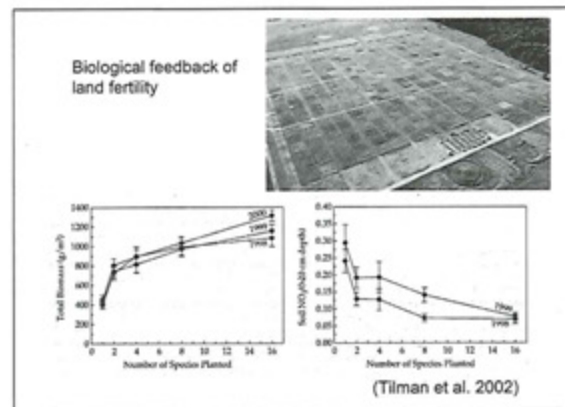
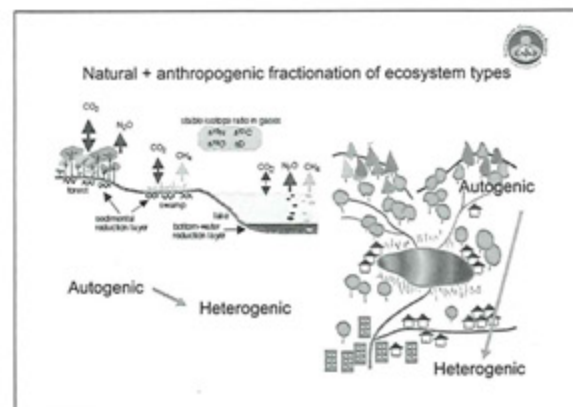
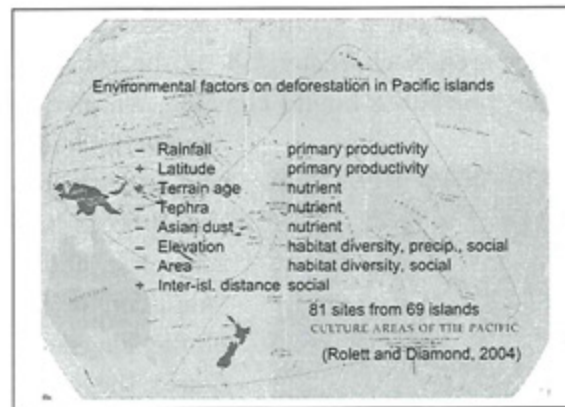
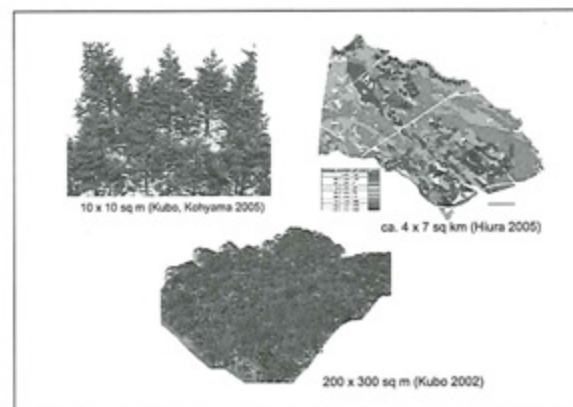
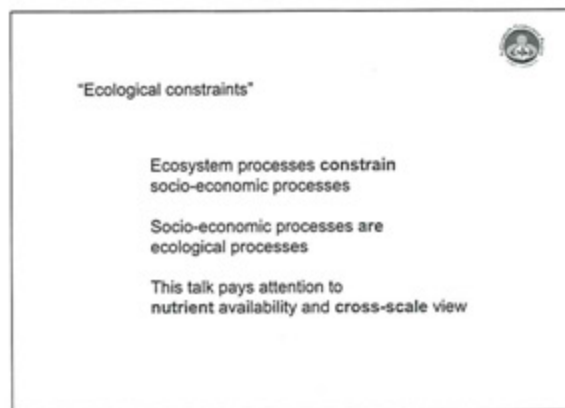
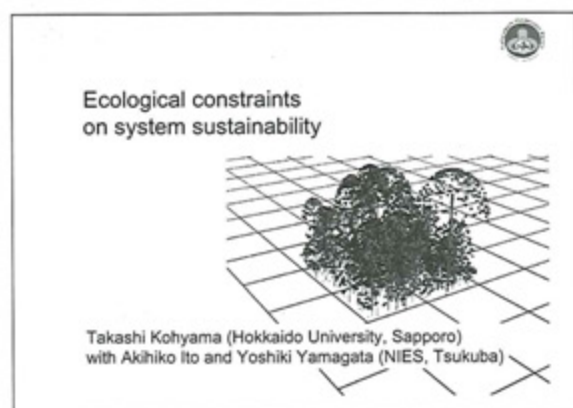


canopy to landscape-scale processes of tree-population demography and tree-community dynamics, and to integrate forest ecosystem processes into watershed-scale budget. So far, physiological screening and micrometeorological monitoring gave a fine-scale validation of land ecosystem processes. However, the prediction of the long-term response of forest systems to global change requires the coupling of ecosystem physiology and tree population demography. To interface the gap between them, we developed multi-scaled models and predicted such processes as the time delay in vegetation response to global change.

Ecosystem modeling uses such procedure to deal with biological units with naturally variable sizes such as biological individuals, species populations, etc. This situation is somewhat similar to social systems, where available statistic data is arranged with municipal/state/country basis with a variable size, and where, for instance, per capita demand of resources by human population is also largely variable. It is also obvious that the maintenance of human population is constrained by net primary productivity (NPP), as a measure of ecosystems. I show examples of relating NPP and vegetation/soil organic mass to the socio-economical

statistics, at various scales, to elucidate emerging unit-scale-dependent components of socio-environmental systems, for the meaningful examination of the system sustainability.

* This paper has been prepared in collaboration with Akihiko Ito and Yoshiaki Yamagata of National Institute for Environmental Studies, Tsukuba, Japan.



Natural + anthropogenic geochemical transportation

Running off
Leaching
Dust translocation
Guano transportation
...

+

Fertilizer trade
Food/fiber trade
Garbage transport

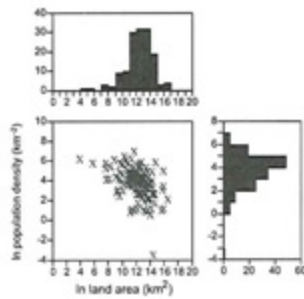
Social/political statistics
social unit basis

Mesh data per unit area
Coupled GCM's

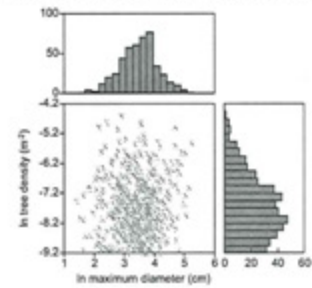
Social/political unit-based analysis

Biological/ecological unit, with a large variation in
physical dimension;
e.g. biological species and individuals

Country variation in land area and population size

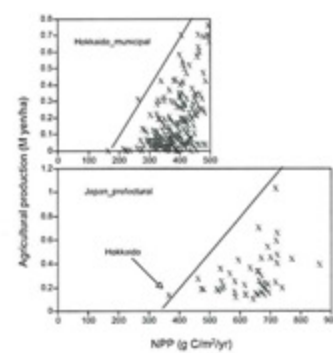


Tree species variation in abundance and maximum size

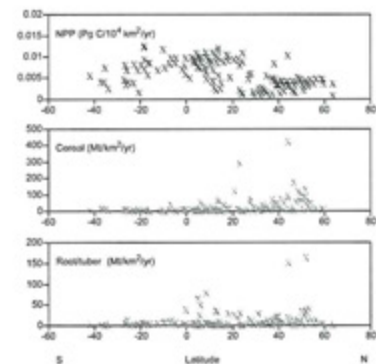


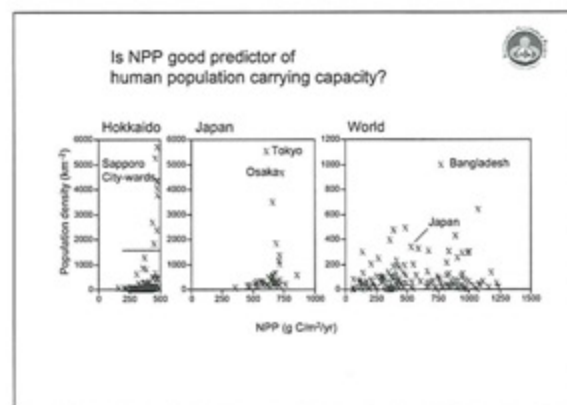
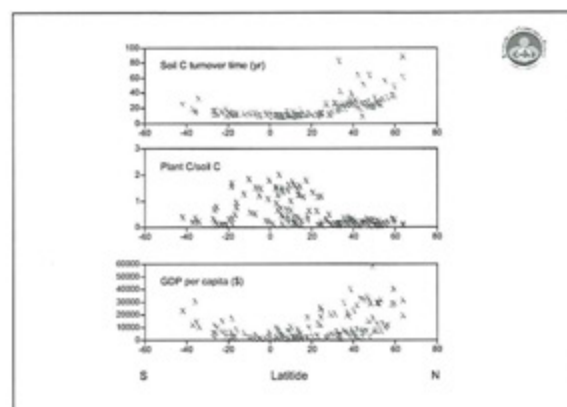
Pasoh 50-ha plot, Malaysia; CTFS, FRIM, AA Harvard Univ.

Net primary productivity (NPP) in mesh map by TsuBiMo Municipal averaging and merging with socio-economic data



NPP and C storage in mesh map by SimCYCLE Nation averaging and merging with socio-economic data





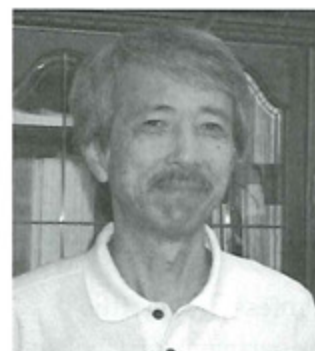
Summary of Plenary Session 1: Sustainability of the Earth System

Chaired by **Motoyoshi Ikeda**

Professor

Faculty of Environmental Earth Science, Hokkaido University

E-mail: mikedai@ees.hokudai.ac.jp



Speakers:

Kevin J. Noone, Executive Director, International Geosphere-Biosphere Programme (IGBP), Sweden

Lawrence A. Mysak, Professor, Department of Atmospheric and Oceanic Sciences, McGill University, Canada

Takashi Kohyama, Professor, Faculty of Environmental Earth Science, Hokkaido University

This session stands on the idea that the earth is under pressure by human activities, and interactions between ecosystem and geosphere play a key role in determining seriousness of the human impacts in near future. On the top of this, we should consider feedback between the natural system and the human system for finding out the optimal way to overcome the difficult and important issue how we can sustain the earth.

Dr. Noone showed an overview of the present and occurring problems within society, such as hunger and diseases, along with the other natural challenges, such as global warming. He pointed out how these issues are interrelated with each other. The examples were teleconnections from deforestation in the tropical Amazon region to the mid-latitude climate, impacts of a changing nitrogen cycle, and a pH decrease caused by carbon dioxide absorption into the ocean. Finally, scientists, resource managers and policy makers require a common understanding of the issues and interactions among themselves.

Dr. Mysak presented the model-predicted glaciation after the current interglacial period and provided an important basis for our decision making during global warming. Milankovitch theory revealed that the next glacial period will be more modest than any previous one in last 400,000 years. In particular, the glaciation is very sensitive to the carbon dioxide content in the atmosphere: i.e., no glaciation will appear under carbon dioxide over 300 ppm in the equilibrium condition. Here, ecosystem-geosphere coupling is a crucial component to determine the glaciation.

Dr. Kohyama suggested the approach to couple ecosystem physiology and tree population demography in order to predict the long-term responses of forest systems to global change. He and his colleagues carried out a synthetic investigation of forests extending from tropical to subarctic zones. One of the important results is that higher ecosystem diversity prevents leakage of soil nutrient. This is one of the reasons why we should include biodiversity in system sustainability.

Recovering Sustainable Water from Wastewater

Takashi Asano

Professor Emeritus
Department of Civil and Environmental Engineering
University of California, Davis, U.S.A.
E-mail: tasano@ucdavis.edu



The sustainability of water resources is of particular importance in light of projected increases in global population. It has been reported that the current world population of 6.2 billion is increasing at a rate of about 1.2 percent per year (United Nations, 2003) with the highest rates of population growth occurring in urban areas in mostly developing countries where supplies of freshwater tend to be limited or already exploited. Increasing urbanization has resulted in an uneven distribution of population and water, thus imposing unprecedented pressures on limited water supplies. These pressures are exacerbated during periods of drought.

For water supplies to be sustainable, the rate at which water is withdrawn from water sources needs to be in balance with the rate of renewal or replenishment of these water sources. In addition to a balance of water quantity, water quality must also be sustainable, recoverable or reusable. Water that is withdrawn for societal needs is also a source of water replenishment that should be considered in the sustainability equation.



Historically, after water has been used for societal needs, it has been labeled as "waste"water and treated to the extent deemed necessary for discharge into a receiving water or for land disposal. During most of the 20th century, the emphasis of wastewater treatment was on pollution abatement, protection of public health, and prevention of environmental degradation through removal of biodegradable material, nutrients, and pathogens. However, over the last few decades, the potential for recovering water from wastewater has been recognized. In fact, in many parts of the world, it is no longer

practical or possible for water to be used only once. Thus, water reclamation, recycling and reuse are one element of water resources development and management that provides a viable option for traditional water supply. Water reclamation, recycling and reuse are multidisciplinary and require close examinations of infrastructure and facilities planning, wastewater treatment plant siting, treatment process reliability, energy considerations, public health, economic and financial analyses, and water utility management involving effective integration of water and reclaimed water functions.

In this presentation, the foundation of water reclamation, recycling and reuse will be discussed and the salient features of implementing water reuse projects including Orange County's Groundwater Replenishment System in California are summarized with considerations for future research needs.

REFERENCE: United Nations (UN Population Division) (2003) *World Population Prospects: The 2002 Revision - Highlights*, United Nations Population Division, Department of Economic and Social Affairs. Accessed at: <http://www.un.org/esa/population/unpop.htm>

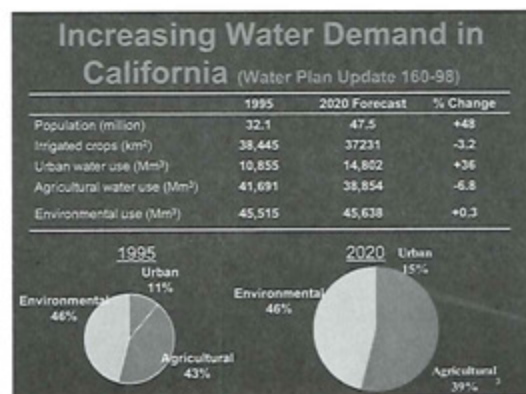
**RECOVERING SUSTAINABLE
WATER FROM WASTEWATER**



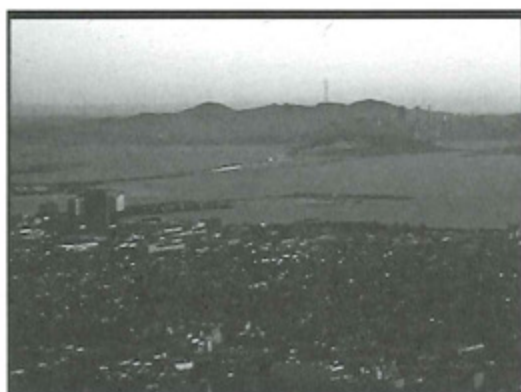
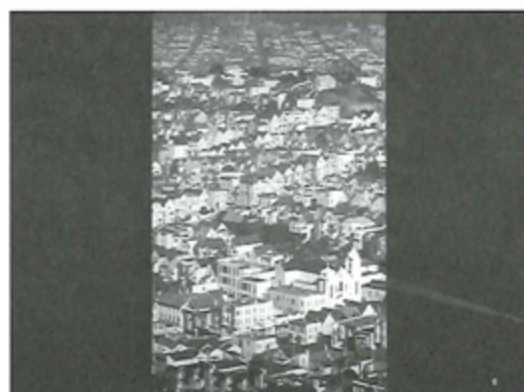
Takashi Asano
Department of Civil and Environmental Engineering
University of California, Davis

Presentation Outline

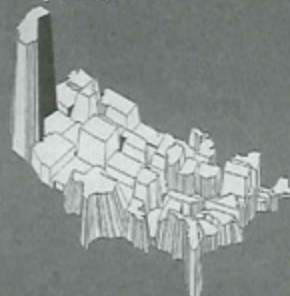
- State of California as an Example
 - Population growth and urbanization
- Sustainability and Water Reuse
 - The role of water reuse with examples
- Water Reuse Issues
 - How safe is water reuse
 - Indirect potable reuse via groundwater recharge: Orange County Water District



Size of CALFED Program Area



Comparison of Water Withdrawals, By States, in 1980.



The total national rate of withdrawal of ground and surface water was 450 billion gallons per day.

Sustainability and Water

- Meet supply and demand

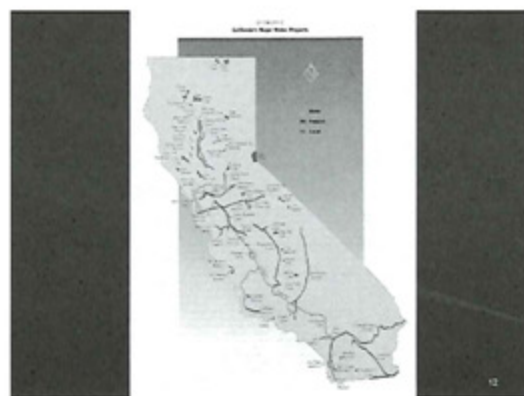


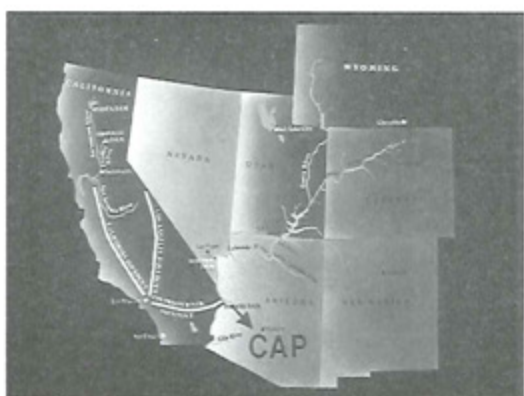
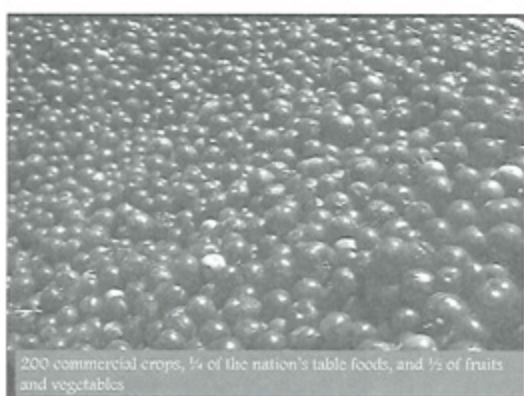
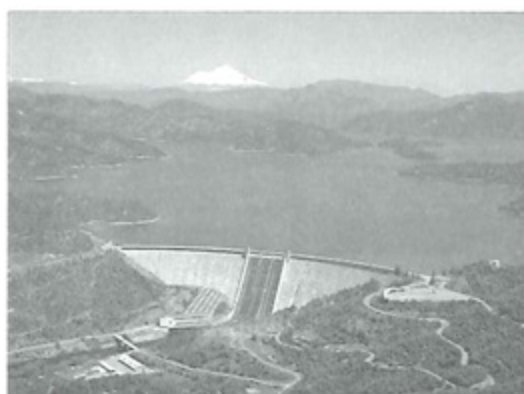
Sustainability and Water

- "We are here consecrating this water supply and dedicating the Aqueduct to you and your children and your children's children for all time".

1908- 1913

Slide: Himmelfarb, 2003





California Water Plan Update 2005

Integrated regional water management

- Use water efficiently
- Protect water quality
- Manage water in ways that protect and restore the environment

DWR Bulletin 160-05 December 2005

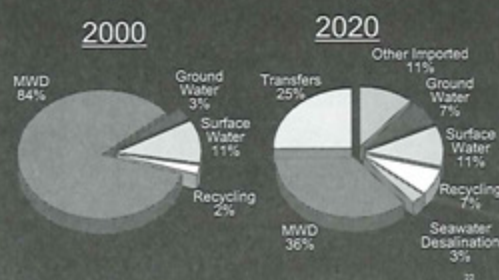
Sustainability and Water

■ Paradigm shift

- Meeting supply and demand no longer sufficient but still necessary
- Quality and quantity
- Demand for highest quality controls all supplies
- Increasingly technical and complex solutions

21

Regional Water Supply Sources Comparison – San Diego, CA



22

Recovering Sustainable Water from Wastewater

23

Task Force Report to the Legislature
(June 2003)

Water Recycling 2030

Recommendations of California's
Regional Water Task Force



24

WATER REUSE IN THE U.S.A.

- U.S.A. - Approx. 4 Billion m³/yr
{11 Mm³/d (3 billion gal/d)} in 2005
Growing at about 15%/yr
(WaterReuse Association)
- California – 648 Mm³/yr (2002)
Goal 1,234 Mm³/yr (2010)
- Florida – 833 Mm³/yr (2003)

25

Water Reuse Definitions

- Wastewater – Used water discharged from homes, business, and cities, e.g. Municipal wastewater (sewage)
- Water reclamation – Treatment or processing of wastewater to make it reusable
- Water reuse – The use of treated wastewater for beneficial use such as agricultural irrigation and industrial cooling

26

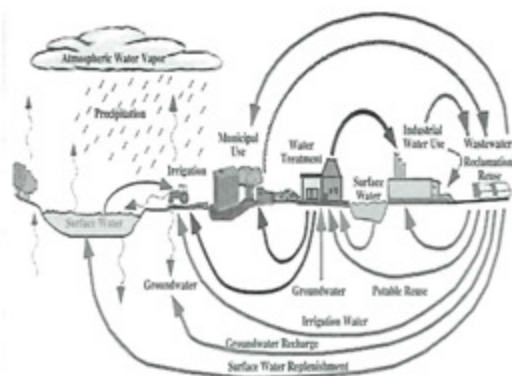
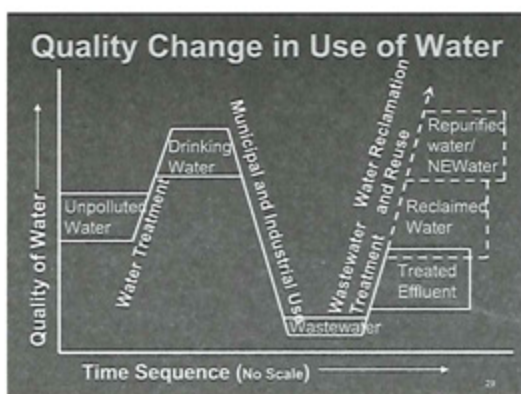
Benefit of Water Reuse

- Important element of integrated water resources management
- Treated effluent is used as a water resource for beneficial purposes
- The wastewater is kept out of streams, lakes, and beaches; thus reducing pollution of surface water and groundwater

27

City of Los Angeles Hyperion Wastewater Treatment Plant 1.7 M m³/d (450 mgd), dedicated on May 15, 1999

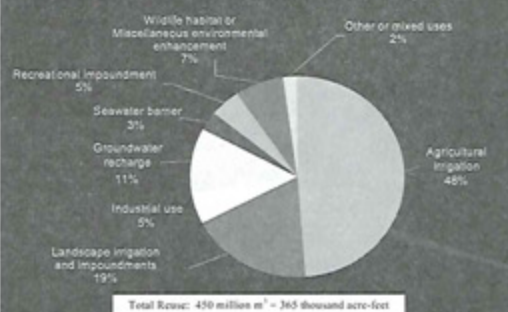




Categories of Reuse

1. Agricultural Irrigation
2. Landscape Irrigation
3. Industrial Reuse
4. Recreational and Environmental
5. Nonpotable Urban Reuses
6. Groundwater Recharge
7. Potable Reuse

Wastewater Reuse





Nonpotable Urban Uses

- Fire Protection
- Air Conditioning
- Toilet Flushing



INDIRECT POTABLE REUSE via groundwater recharge

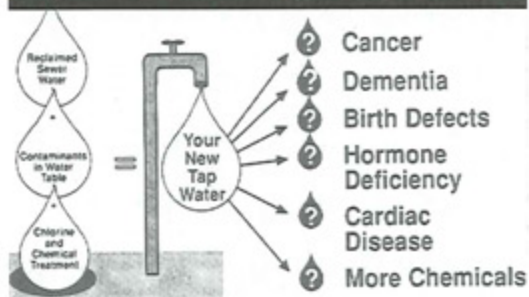
- Regulatory Framework—1996
- Groundwater Recharge Criteria—2003
 - Control of pathogens and trace organics
- Spreading:
 - Disinfected Tertiary Treatment
 - 6- Month Retention
 - 150 m (500 ft) Distance
- Injection:
 - Disinfected Advanced Treatment
 - 12-Month Retention
 - 600 m (2,000 ft) Distance

45

The Dreaded Sewage Molecule!



Scare tactic: Toilet-to-Tap Made Simple

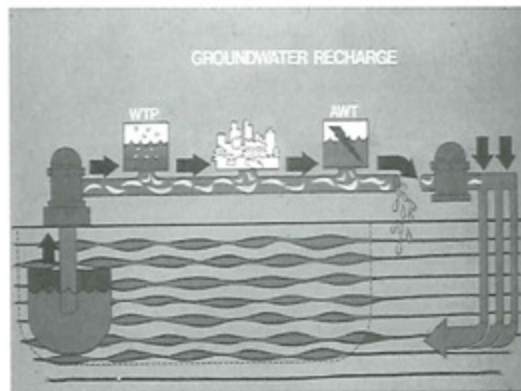
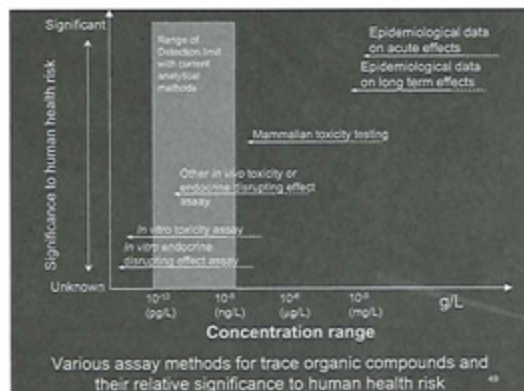


Endocrine Disrupting Compounds (EDCs)

Pharmaceutically Active Compounds (PhACs)

Pharmaceuticals & Personal Care Products (PPCPs)

Courtesy of Dr. Shane Snyder, Southern Nevada Water Authority



Orange County Water District

<http://www.ocwd.com/>

- Formed in 1933 to protect rights to water in the Santa Ana River
- Manage groundwater basins that supplies > 20 cities and > 2 million residents
- Source of recharge water: Santa Ana, Colorado, State Water Projects, and reclaimed water
- Water Factory 21 1976 - 2000: $57 \times 10^3 \text{ m}^3/\text{d}$ (15 mgd)
- Groundwater Replenishment (GWR) System, $236 (473) \times 10^3 \text{ m}^3/\text{d}$ \$487 Million project; O&M annual cost \$26 million, opens 2007.

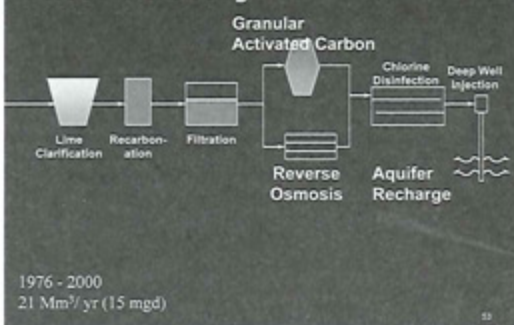
51

Water Factory 21



52

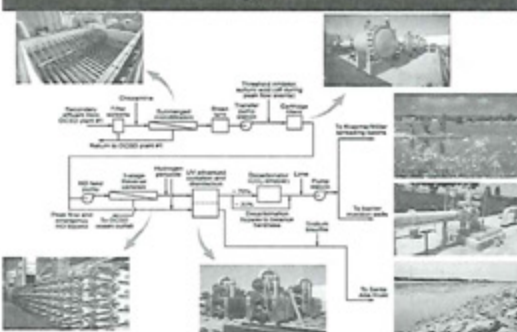
Water Factory 21



What is the Groundwater Replenishment System?

- Indirect potable reuse project
 - Phase I — 236 x 10³ m³/d
 - Ultimate Capacity — 473 x 10³ m³/d
- Treatment: 100% MF, RO & UV + H₂O₂
- Half the water will be injected into wells for a seawater intrusion barrier
- Half the water will be percolated into the groundwater basin
- Partnering agencies: OCWD and OCSD

GWRS being constructed



Energy requirement for water delivery to Orange County

Various water sources	Energy requirement, kWh/m ³
Desalination	3.5 – 4.0
State water project	2.62
Colorado River	1.82
Groundwater Replenishment (GWR) System	1.19

Adapted from Orange County Water District, 2006.



Local Benefits of GWRS

- Provides reliable, local water supply
- Improves water quality
- Helps drought-proof Orange County
- Protects groundwater basin from seawater intrusion
- Reuses valuable resource
- Decreases wastewater discharge to ocean

Trends in Water Reuse

- Integrated regional water resource planning
- Dual distribution systems
- Decentralized systems
- Push for planned indirect potable reuse
- UV disinfection
- Membrane processes: MF and RO
- Microbial and chemical risk assessments
- Regulatory development
- Public communication and perception studies

IDP Implementation Issues

- The need for new water is becoming critical
- Non-potable water reuse may reach practical limits
- Technology for IPR is mature, now
- Costs are competitive, now
- Public acceptance is not assured
- Communication of value, benefits, alternatives is essential
- Once Implemented, opposition may melt away

Editorial: Yuck!; San Diego should flush "toilet to tap" plan

San Diego Union-Tribune — 7/24/06

■ RECYCLED DRINKING WATER:

Your golden retriever may drink out of the toilet with no ill effects. But that doesn't mean humans should do the same. San Diego's infamous "toilet to tap" plan is back once again, courtesy of Water Department bureaucrats who are prodding the City Council to adopt this very costly boondoggle. The project was rightly shelved seven years ago amid a public outcry over potential health hazards and the fact that some of San Diego's least affluent neighborhoods were to be the recipients of the treated wastewater.

San Diegans do not need to run the risks associated with drinking toilet water. The City Council should reject this project once and for all.

Mottainai: A Comparative Study of the Politics of Innovation in Waste Management

Miranda Schreurs

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Consumer societies are being faced by increasingly difficult and pressing problems related to waste management. Household waste contains an increasingly large share of electronic products--computers, televisions, DVDs--that have added new challenges for municipalities that already have great difficulties in disposing of waste.

This paper examines innovative measures that are being developed to reduce waste at its source in the European

Union, Japan, and the United States and considers how policy ideas are diffusing across borders.

もったいない (Mottainai):
A Comparative Study of the
Politics of Innovation in Waste
Management

Miranda A. Schreurs
University of Maryland

もったいない

- Mottainai: it is a shame to throw this away or not to use it as it could still be useful and so much went into making it what it is

Wangari Maathai, 2004 Nobel Peace Prize.



The Politics of Waste and the Role of Governments

- US led innovations in hazardous waste response
- EU, Japan are leading when it comes to recycling, circular economies
- US, at federal level, focuses on education and voluntary methods

History of Waste: Fun Facts

Source: US EPA

- 1690 First paper recycling mill in US
- 1757 Ben Franklin organizes municipal street clean service in Philadelphia
- 1874 Nottingham England, development of the "destructor" (an incinerator)
- 1885 NY builds its first incinerator
- 1899 NYC organizes first recycling plant in US
- 1904 First aluminum recycling plant

Where to with your Waste?

- 1900s, piggeries developed in small and medium towns to use food waste
- 1902, 70% of 161 towns offered refuse collection
- 1914, estimated 300 incinerators in US, Canada
- 1920s, wetlands used for garbage dumping
- 1934, US bans municipal dumping of waste in ocean
- WWII, big push for recycling of materials, 25% of waste stream recycled
- 1940s, first sanitary landfills emerge
- 1950s, Open burning dumps used in many cities

Rivers on Fire



Cuyahoga River Fire

1969, oil wastes in the Cuyahoga River in Ohio caught fire

The river had caught on fire before: in 1936 and 1952

Became a symbol of a polluted United States

The US: Hazardous Waste Crisis and Response

1965 Federal Solid Waste Disposal Act (focused on research)

1976 Resource Recovery and Response Act

1978-80 Love Canal
(Super Fund Legislation)

1984 Bhopal Disaster
(Emergency Planning & Community Right to Know Act; Toxic Release Inventory)

1989 Exxon Valdez Oil Spill
(Oil Pollution Prevention Act of 1990)

Resource Conservation and Recovery Act 1976

Gave EPA authority to control hazardous waste from cradle to grave.

Set framework for management of non-hazardous wastes

Amended 1984 phasing out landfilling of hazardous wastes

Amended 1986 to address underground tanks storing petroleum and other hazardous substances

Amended in 1987/8 to authorize EPA to initiate educ program on problems of plastics in marine environment; restricted use of plastic ring carriers; tracking of medical waste

Love Canal: 1978-1980

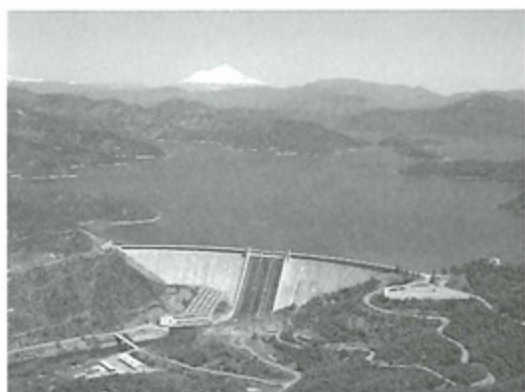
University Archives, State University of New York at Buffalo



Infamous aerial photo of Love Canal area taken in spring 1978 showing that Superfund chemicals had seeped into yards of homes. Superfund chemicals were a waste disposal byproduct of waste right. While posing serious health risks, the chemicals were not supposed to be dumped in the area.



Lois Gibbs and the Love Canal Home Owners Association



SUPERFUND

- Provides a federal superfund for the clean-up of abandoned hazardous waste sites as well as accidents, spills, and other emergency releases of pollutants
- Makes a broad class of parties strictly liable for clean up costs for releases of hazardous substances

SUPERFUND 25th Anniversary



- As of Dec 2005, Superfund construction had been conducted at over 900 federal and private sites
- But 1 in 4 Americans lives within 3 miles (4.8 km) of a Superfund Site

Before

When the chemical plant shut down, leaving an emergency station in the community. Superfund was set up to remove the waste from the site. Left behind by the Chemical Disposal Corporation of Environmental Quality, Petroleum Refinery, Chemicals, and Chemicals.



Hidden dangers

A few water samples in the pond for consumption coming from the refinery in the background. Since the Chemical Disposal Corporation, the Petroleum Refinery, Chemicals, and Chemicals.

(See: Love Canal and Superfund 25th Anniversary)



1984 Bhopal: The world's worst chemical disaster

BBC pictures



Bhopal

Dec 3, 1984 –

- Union Carbide Co. fertilizer plant leaks methyl isocyanide
- 2000 dead, another 8,000 die of chronic effects. Estimated 2000 casualties, 100,000 injuries, and significant damage to livestock and crops.

Emergency Planning & Community Right to Know Act

- required establishment of state emergency planning commissions
- requires companies to notify authorities of extremely hazardous substances above certain quantities
- requires companies to report annually on toxic releases of over 600 chemicals, info made available to public

Toxic Release Inventory

- Publicly available database of annual releases of toxic chemicals
- Made available to the public through www.scorecard.org
- Communities have used this information to pressure companies to reduce their emissions
- Many companies have reduced their chemical use voluntarily as a result of TRI

Toxic Release Inventory



Montgomery County, MD

Pounds			
1	WICKESVILLE TOWNSHIP	DICKERSON	2038708
2	WICKESVILLE TOWNSHIP	ROCKVILLE	547
3	WICKESVILLE TOWNSHIP	ROCKVILLE	510
4	WICKESVILLE TOWNSHIP	DICKERSON	250
5	WICKESVILLE TOWNSHIP	GAITHERSBURG	11
6	WICKESVILLE TOWNSHIP	GAITHERSBURG	8
7	WICKESVILLE TOWNSHIP	GERMANTOWN	0

States with Animal Waste (TRI)

Rank	State	Tons of Waste in 1992
1.	ILLINOIS	110,000,000
2.	CALIFORNIA	55,000,000
3.	IOWA	51,000,000
4.	GEORGIA	47,000,000
5.	KANSAS	46,000,000
6.	INDIANA	39,000,000
7.	OKLAHOMA	36,000,000
8.	MISSOURI	35,000,000
9.	MINNESOTA	33,000,000
10.	NORTH CAROLINA	31,000,000

Education/Voluntary Activities for Waste Reduction

- Reduce, reuse, recycle (Resource Conservation Challenge)
- voluntary, education focused program

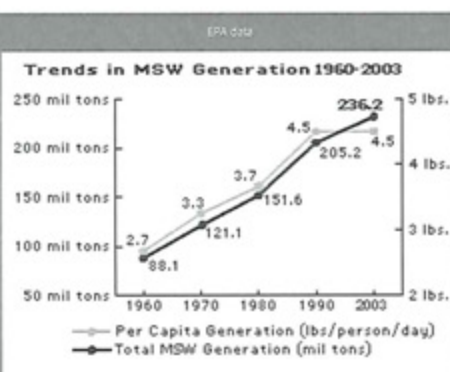
-Earth 911

Earth 911

- Provides information about local recycling services identified by zip code across the country
- Household hazardous waste
- Aluminum Can recycling
- Cell phone and computer recycling
- Paints
- Mercury

Earth 911: Computers

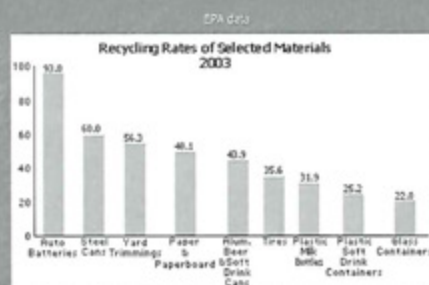
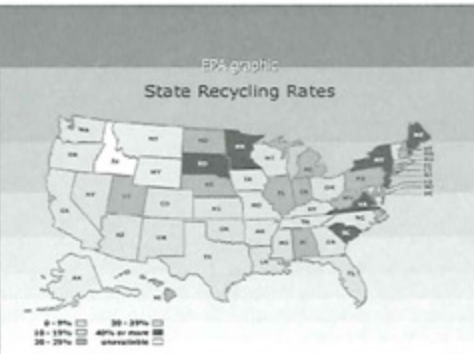
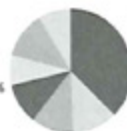
- Computer donation
- Computer recycling information
- Computer components recycling



US municipal solid waste generation (EPA data)

2003 Total Waste Generation—
236 Million Tons
(before recycling)

- Paper 35.2%
- Yard Trimmings 12.1%
- Food Scraps 11.7%
- Plastics 11.3%
- Metals 8.0%
- Rubber, Leather, and Textiles 7.4%
- Glass 5.3%
- Wood 5.0%
- Other 3.4%



U.S. Cities Recycling Rates

(Waste Aides 2001 data)

- Portland 53.6%
- Seattle 52%
- Chicago 47.9%
- San Jose 47%
- San Diego 46%
- San Francisco 42%
- LA 40.9%
- Baltimore 35.3%
- New York 19.7%

The Role of the Federal Govt in Recycling

1991 Federal Agency Recycling Exec. Order
1998 Federal Acquisition, Waste Prevention, and Recycling Exec. Order

The US Federal government has limited its role in household recycling and producer packaging matters to education and promoting voluntary initiatives

The States Take the Lead: 2003 CA's Electro Waste Recycling Act

- reduction of hazardous wastes in certain electronic products sold in CA
- collection of electronic waste recycling fee at point of sale of certain products
- distribution of recovery and recycling payments to qualified entities
- recommend env'ly friendly purchasing criteria for state entities

Public-Private Partnerships



Stockholm Convention on Persistent Organic Pollutants

- Global treaty to protect human health and environment from Persistent Organic Pollutants (POPs)

(US has signed but not ratified; Japan and EU have both ratified)

Lessons for Sustainability: How does the US Compare?

Planet Ark: Recycling Olympics National Municipal Waste Generation (kg/person)

- | | |
|--------------|-----------------|
| Japan 410 | UK 580 |
| Portugal 440 | Germany 590 |
| Sweden 470 | Spain 650 |
| Italy 510 | Switzerland 660 |
| France 530 | Australia 690 |
| | USA 730 |

Planet Ark: Recycling Olympics Paper and Cardboard

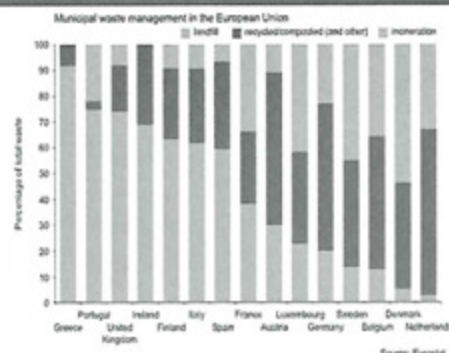
- | | |
|-------------------|---------------|
| Germany 70% | Australia 47% |
| Sweden, Switz 63% | Portugal 46% |
| Japan 59% | USA 42% |
| France 50% | UK 41% |
| Spain 48% | Italy 37% |

Planet Ark: Recycling Olympics National Rankings

- 1-Japan
- 2-Sweden
- 3-Switzerland
- 4-Germany
- 5-France
- 6-Australia, Italy
- 8-Portugal
- 9-Spain, US
- 11-UK

The European Union

Pioneering New Approaches to
Waste Reduction, Recycling,
Reuse



EU: Regulatory Developments Influenced by US law

- 1975 Framework Directive on Waste Management
- Seveso I (1982) and II (1996) (Chemical Accident Prevention, Preparedness, Response)
- 1991 Controlled Management of Hazardous Wastes
- 1996 Integrated Pollution Prevention and Control (requires highly polluting industries and agricultural operators to have a permit which can only be used if environmental conditions are met)

EU Taking the Lead

- Reduction, reuse, recycle
- Development of Recycling society
- Producer Responsibility

1994 EU Packaging Directive

- Harmonizes national legislation
- Requires members to take measures to reduce packaging waste and promote reuse
- Reduces heavy metal content
- Requires intro of systems to return/collect used packaging
- Establishes recycling targets
- Harmonizes data bases

End of Use Vehicles

- Reduces use of hazardous substances
- Encourages design of vehicles to be recycling friendly
- Encourages use of recycled parts
- Introduces provisions on collection and recycling of used vehicles

6th Environment Action Programme

- Set target of developing recycling society
- Commission proposed new strategy on prevention and recycling of waste
- Proposes revising 1975 Waste Framework Directive to set recycling standards and oblige members to develop national waste prevention programs

EU Directives on Recycling

- Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment
- Directive 2002/96/EC on waste electrical and electronic equipment (WEEE)

EU Approves Battery Recycling Law (July 2006)

- Will standardize measures for the collection and recycling of batteries and accumulators
- Shops will be required to dispose of spent batteries
- New batteries will be restricted in the amount of mercury and cadmium they may contain
- Will require more accurate labelling

Waste Management Laws

- 1970 Waste Management Law
- 1972 Industrial safety and health law
- 1972 Ordinance on prevention of hazards due to specified chemical substances

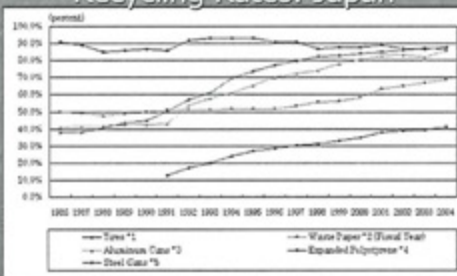
Japan: Catching up & Surpassing the EU?

- 1991 Law for the Effective Utilization of Resources (reduce by-products, reuse recycled materials, reducing end-of-life waste, making products that are easily recycled, taking back end of life products (batteries, PCs))
- Enactment of a Fundamental Law for Establishing a Sound Material Cycling Society (June 2000)
- Fundamental Plan for a Sound Material Cycling Society (2003)

Japanese Regulations

- Action Plan for Greening Government Purchases
- Packaging Recycling Law
- Electric Appliances Recycling Law
- Construction Waste Recycling Law
- Food Waste Recycling Law
- End of Life Vehicle Recycling Law (2002, entered into force 2004)

Recycling Rates: Japan



Recycling in Japan: 44 categories in Kamikatsu!



Sustainable and Cyclical Economy of Asia: Overview

Fumikazu Yoshida

Professor
Graduate School of Public Policy
Hokkaido University
E-mail: yoshida@econ.hokudai.ac.jp



Cross-Border Resource Cycling

Because of economic globalization, the material cycle has totally transcended national borders. In particular, imports and exports of scrap metal, post-consumer waste paper, waste plastic, and other reclaimed materials are booming due to heavy demand stemming from falling demand in Japan and to Asian economic growth.

Building a Cyclical Society Including All of East Asia

East Asia already has a large product and material cycle, making it impossible to create a cyclical society conceived for Japan alone. Therefore I would like to discuss the challenges for each actor in building a cyclical society system in East Asia, while taking into consideration the proposals mentioned thus far.



First, it is essential to assemble statistical data on the used consumer appliances/electronics and automobiles that are exported. This is impossible to determine from current Ministry of Finance customs statistics. We must also find out how resources are being recycled in importing countries. In view of the need for this information, the government must start by assembling statistics.

Second, information exchange and discussions on wide-area recycling should be carried out on the government level. Haste is needed especially on issues related to the Basel Convention. The

EU practices wide-area waste management on the grounds that within the EU this does not constitute transboundary movement under the convention.

Third, in relation to manufacturers, the government should consider the application of EPR

to used products and those produced overseas. Unless this is done, exporters cannot escape criticism that they are trying to avoid domestic environmental regulations.

And fourth, recyclers should run recycling businesses - not only in Japan, but in other Asian countries as well - that use their technology and expertise to advantage. Of course environmental friendliness and transparency will be crucial, and they should start with pilot projects.

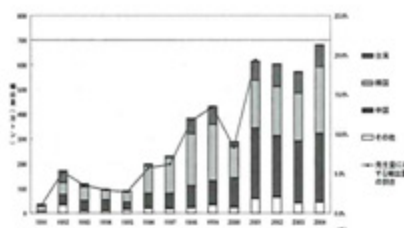
Sustainable and Cyclical Economy of Asia: Overview

Fumikazu Yoshida
Hokkaido University

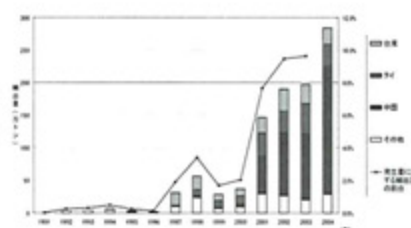
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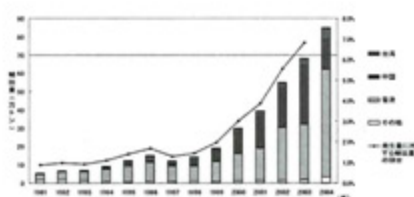
Cross-Border Resource Cycling Ferrous scrap exports and importing countries from Japan



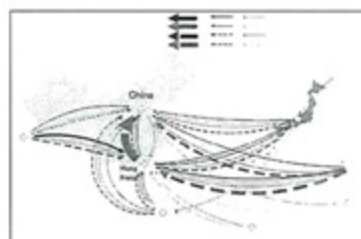
Waste paper exports and importing countries from Japan



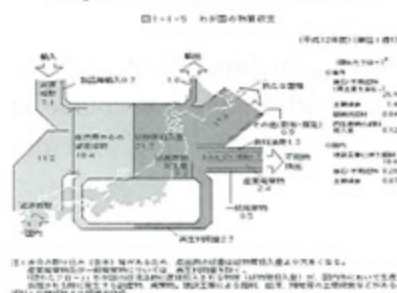
Plastic scrap exports and importing countries from Japan



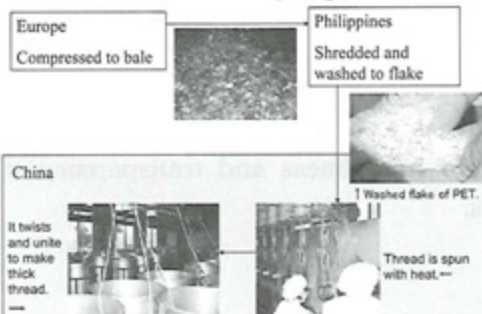
Material flows of plastic waste among Japan, China, and Hong Kong in 2001. by Terazono



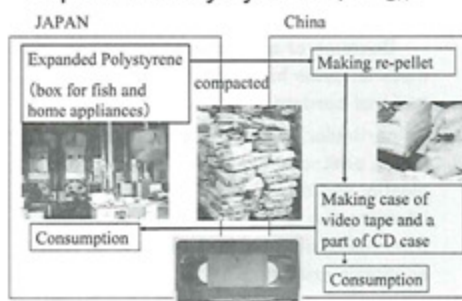
Japan's Material Flow



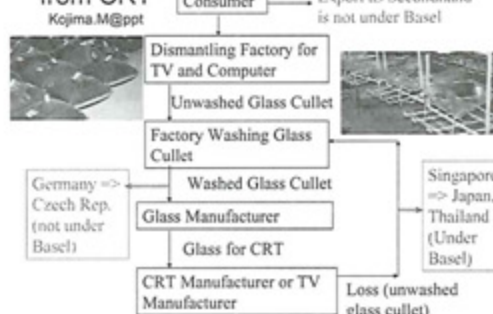
PET Bottle



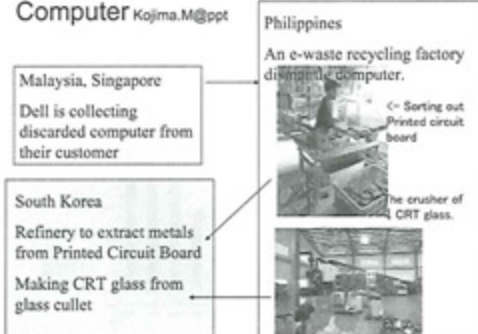
Expanded Polystyrene



Glass Cullet from CRT



Computer



Copy Machine collected by Fuji Xerox in Asia and Pacific



Waste Import by Selected Asian Countries in 2005 (unit: thousand ton)

	Plastics	Paper	Steel	Copper	Al.
China	4956	17032	10135	4820	1687
Indonesia	4	1957	1202	13	23
Japan	3	77	181	102	108
S. Korea	24	1349	6813	205	297
Malaysia	75	166	3370	236	*
Philippines	7	287	13	4	0
Thailand	1	946	1683	5	31

Note: * : Not reliable data

Source: Trade statistics of each countries.
Kojima.M @ppt

Pollution from Recycling of Imported Waste

- Basel Action Network and Silicon Valley Toxics Coalition published "Exporting Harm" in February 2002, which report the pollution from e-waste recycling in Guiyu, Guangdong, China.
- Although Chinese government tightened the prohibition of importing e-waste. But e-waste recycling in Guiyu still cause pollution.



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H5N1 influenza viruses from ducks in China



Second: Basel Convention

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Third: EPR

- In relation to manufacturers, the government should consider the application of EPR to used products and those produced overseas. Unless this is done, exporters cannot escape criticism that they are trying to avoid domestic environmental regulations.

Fourth: environmental friendliness and transparency

- Recyclers should run recycling businesses — not only in Japan, but in other Asian countries as well — that use their technology and expertise to advantage. Of course environmental friendliness and transparency will be crucial, and they should start with pilot projects.

Summary of Plenary Session 2: Sustainable Society with Recycling System

Chaired by **Yoshimasa Watanabe**

Professor

Graduate School of Engineering, Hokkaido University

E-mail: yoshiw@eng.hokudai.ac.jp



Speakers:

Takashi Asano, Professor Emeritus, Department of Civil and Environmental Engineering, University of California, Davis, U.S.A.

Miranda Schreurs, Associate Professor, Department of Government and Politics, University of Maryland, U.S.A.

Fumikazu Yoshida, Professor, Graduate School of Public Policy, Hokkaido University

The sustainability of water resources is of particular importance in light of projected increase in global population. For water supplies to be sustainable, the rate at which water is withdrawn from water sources needs to be in balance with the rate of renewal or replenishment of these water sources. In addition to a balance of water quantity, water quality must also be sustainable, recoverable and reusable. Water that is withdrawn for societal needs is also a source of water replenishment that should be considered in the sustainability equation. Prof. Asano presented the foundation of water reclamation, recycling and reuse. He summarized the salient features of implementing water reuse project including Orange County's Groundwater Replenishment System in California.

Consumer societies are being faced by increasingly difficult and pressing problems related to waste management. Household waste contains an increasingly large share of electronic products-computers, televisions, DVDs-that have added new challenges for municipalities that already have great difficulties in disposing of waste. Prof. Schreurs talked about innovation measures that are being developed to reduce waste at its source in the European Union, Japan and United States and considered how policy ideas are diffusing across borders.

Because of economic globalization, the material cycle has totally transcended national borders. In particular, imports and exports of scrap metal, post-consumer waste paper, waste plastic, and other reclaimed materials are booming due to heavy demand stemming from falling demand in Japan and to Asian economic growth. Prof. Yoshida discussed the challenges for each actor in building a cyclical society system in East Asia.

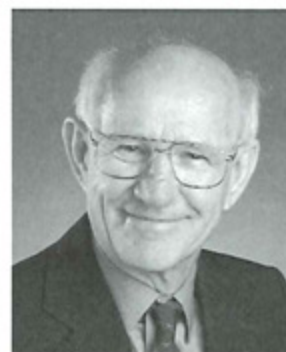
Origin and Evolution of Influenza Virus

Robert G. Webster

Professor

Division of Virology, Department of Infectious Diseases,
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E-mail: robert.webster@stjude.org

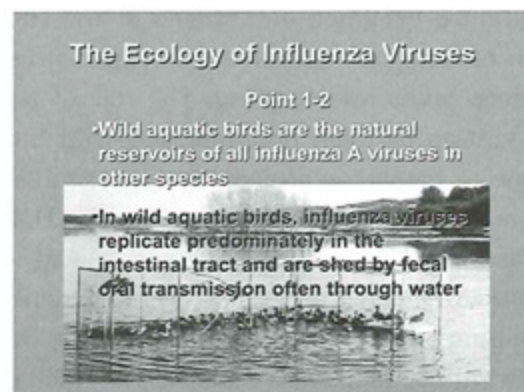
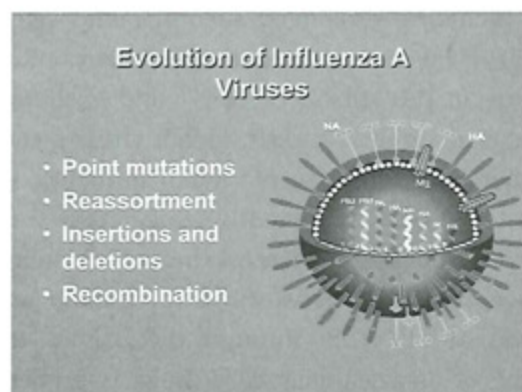
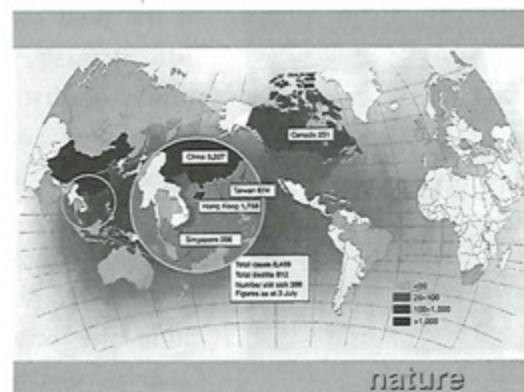
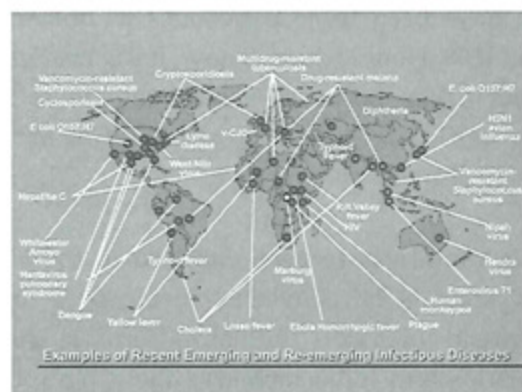
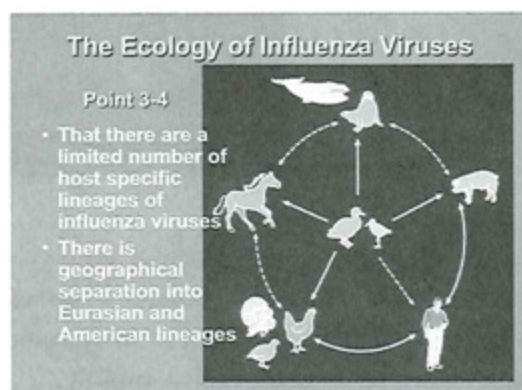
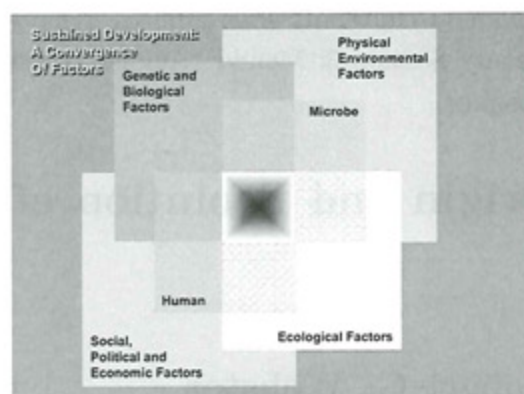
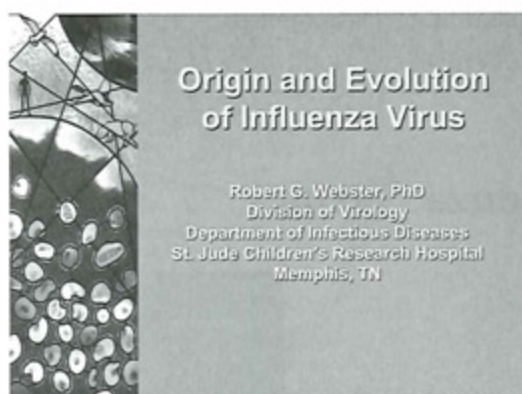


Pandemic influenza is a zoonotic disease caused by the transfer of influenza A viruses or virus gene segments from aquatic bird reservoirs to humans and domestic animals. In wild aquatic birds - the natural hosts of all influenza viruses - these viruses exist in harmony with their natural host. After transfer to other species influenza viruses evolve rapidly.



In the past century there have been three pandemics in humans: 1918 Spanish, 1957 Asian, 1968 Hong Kong. These have emerged after reassortment between human influenza viruses and those in the aquatic birds of the world or directly from avian sources probably via intermediate hosts.

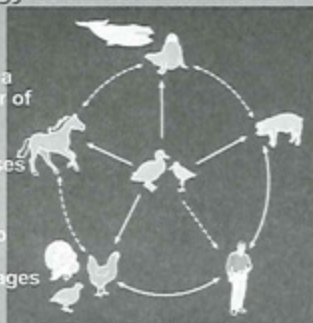
The pandemics of the past century have been confined to the H1, H2 and H3 subtypes but there is no convincing evidence to exclude the others. The spread of H5N1 influenza viruses from Eastern Asia to Europe, Africa and India increases the geographical range and pandemic potential of this virus. Ducks are playing an important role in the continued evolution and spread of the H5N1 viruses including prolonged shedding and selection of antigenic variants. The H5N1 viruses from 2004-2006 are highly pathogenic in poultry, ferrets, felids and humans. The role of migrating birds in the spread of H5N1 and exchange of viruses between domestic and wild birds in Asia is of great concern. H5N1 viruses continue to break the ecological rules established for other highly pathogenic avian influenza viruses. What are the prospects for the H5N1/06 virus to become consistently transmitted from human to human and cause a global catastrophe? Options for control include increase biosecurity and the use of reverse genetics to produce standardized vaccines for human and veterinary use. The immediate control of the spread of H5N1 is through the use of the antiviral neuraminidase inhibitors. Continuing stockpiling of anti-neuraminidase drugs is prudent.



The Ecology of Influenza Viruses

Point 3-4

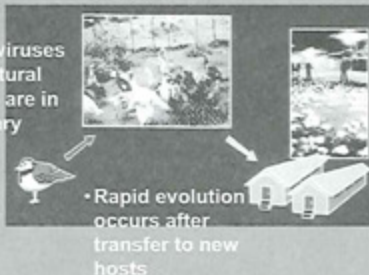
- That there are a limited number of host specific lineages of influenza viruses
- There is geographical separation into Eurasian and American lineages



The Ecology of Influenza Viruses

Point 5-6

- Influenza viruses in their natural reservoirs are in evolutionary stasis



The Ecology of Influenza Viruses

Point 7-8

- Most interspecies transmissions are transitory and do not result in stable lineages
- Intermediate hosts involved in interspecies transmission of avian influenza viruses include pigs, chickens, and quail



Influenza A Virus Host Range

H1				
H2				
H3				
H4				
H5				
H6				
H7				
H8				
H9				
H10				
H11				
H12				
H13				
H14				
H15				
H16				

The Avian Influenza Genome Project

- 413 avian influenza viruses
- "proteotyping" or bar-codes for rapid analysis of data
 - Certain proteins inherited as pairs
- Variation in HA, NA, NS



Cavanagh et al 2000

Reassortment/Recombination

- Reassortment of gene segments is rampant, especially HA, NA
- Evidence for homologous recombination not found

→ a rare event

Genesis of H5N1 Influenza In Asia

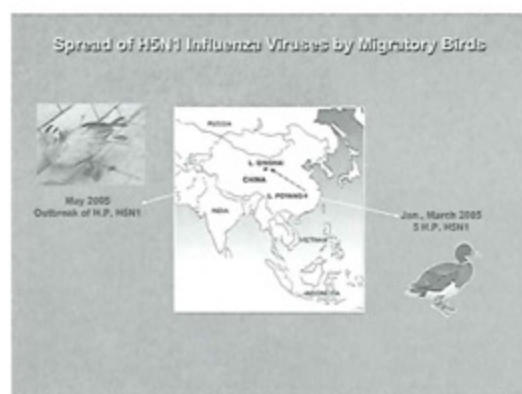
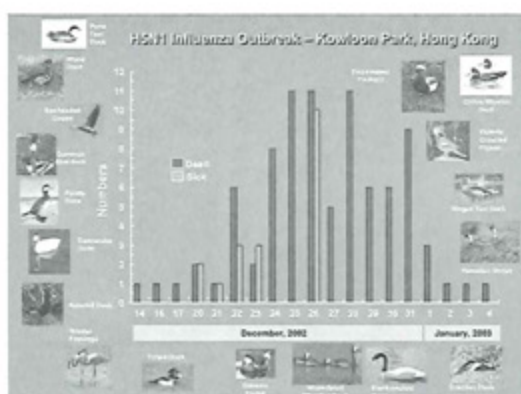


- 1996 Goose/Guangdong/1/96 (H5N1)
- 1997 Emergence of H5N1 Bird Flu
- A reassortant
- Goose X Quail X Duck
- H5N1 H5N2 H5N1
- 6 of 18 infected persons died
- 1997-2002 ➢ Multiple genotypes
- 2003-2005 ➢ Pathogenic for aquatic birds
- Spread across Asia

H5N1 influenza viruses from ducks in China



Chen et al 2004

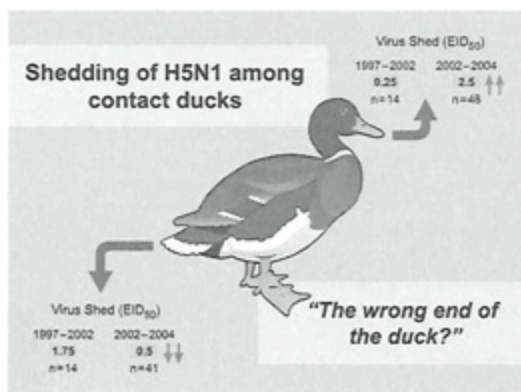


Serological Analysis of Migratory Ducks in China 2005

No. Examined	Serological Reactivity With:	
	DK/JX/3345/05 (H5N2) [LP]	MDK/JX/1653/05 (H5N1) [HP]
1092	47 (4.3%)	34 (3.1%)

Pathogenicity of H5N1 Viruses for Ducks and Geese

Virus	Date of Isolation	Lethality for:	
		Ducks	Geese
Mallard duck/JX/05	January/05	4/9	6/6
Bar-headed goose/QH/05	May/05	0/9	6/6

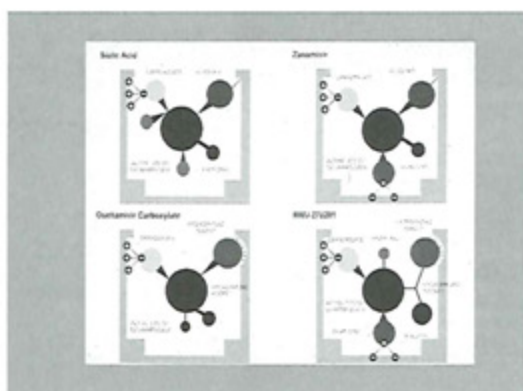
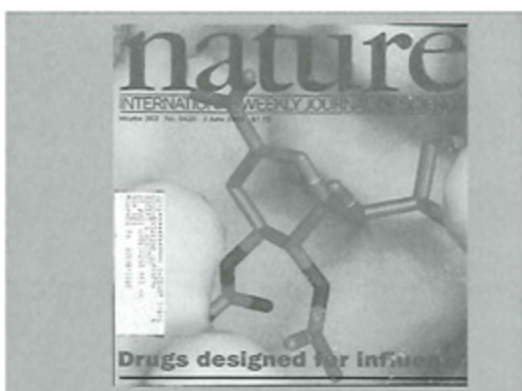
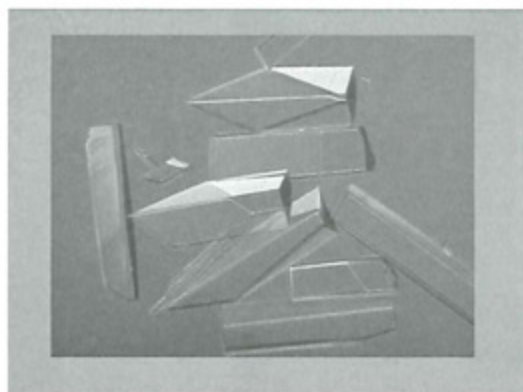


When H5N1 emerged in Southern China in 1996 the current strategy for making anti-influenza drugs and vaccines did not exist

- The importance of sustained development:
 - Development of anti neuraminidase drugs
 - Development of reverse genetics for vaccines and understanding pathogenesis

Sustained Development

Development of antineuraminidase drugs

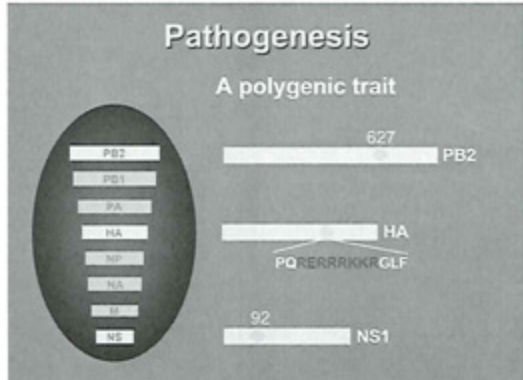
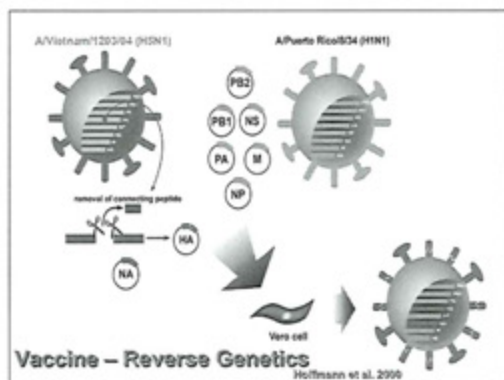


Surveillance to Drug Design

- Reservoirs of influenza A in aquatic birds of the world
- Structure of the neuraminidase
- Design of neuraminidase inhibitors
- The structure of an antibody combining site

Sustained Development

- Development of Reverse Genetics
- Palese – Kawaoka – Hoffmann



Pathogenicity of H5N1 Isolates in the Following Hosts?

	Chicken	Ducks	Ferrets	Mice
JSN/1129/04	++++	++++	++++	++++
JSN/1129/04	++++	-	-	-

Role of HA and NA?

Reassortant Virus	H5N1 Gene Segment								Lethality in Ferrets / Mice	
	PB2	PB1	PA	HA	NP	NA	M	NS		
CH22	✓	✓	✓	✓	✓	✓	✓	✓	9%	9%
VR295	✓	✓	✓	✓	✓	✓	✓	✓	100%	100%
VR295-CH22(1-12)	✓	✓	✓	✓	✓	✓	✓	✓	100%	100%

Salomon et al., 2006 JEM

Role of Polymerase Complex Genes?

Reassortant Virus	H5N1 Gene Segment								Lethality in Ferrets / Mice	
	PB2	PB1	PA	HA	NP	NA	M	NS		
CH22	✓	✓	✓	✓	✓	✓	✓	✓	9%	9%
VR295	✓	✓	✓	✓	✓	✓	✓	✓	100%	100%
VR295-CH22(1-12)	✓	✓	✓	✓	✓	✓	✓	✓	9%	9%

Salomon et al., 2006 JEM

Role of PB2?

Reassortant Virus	H5N1 Gene Segment								Lethality in Ferrets / Mice	
	PB2	PB1	PA	HA	NP	NA	M	NS		
CH22	✓	✓	✓	✓	✓	✓	✓	✓	9%	9%
VR295	✓	✓	✓	✓	✓	✓	✓	✓	100%	100%
VR295-CH22(1-12)	✓	✓	✓	✓	✓	✓	✓	✓	33%	33%

Salomon et al., 2006 JEM

Role of NS?

Reassortant Virus	H5N1 Gene Segment								Lethality in Ferrets / Mice	
	PB2	PB1	PA	HA	NP	NA	M	NS		
CH22	✓	✓	✓	✓	✓	✓	✓	✓	9%	9%
VR295	✓	✓	✓	✓	✓	✓	✓	✓	100%	100%
VR295-CH22(1-12)	✓	✓	✓	✓	✓	✓	✓	✓	10%	10%

Salomon et al., 2006 JEM

Which Genes of H5N1 are Responsible for Virulence in Mammals?

Gene	Amino acid Differences
• PB2	4
• PB1	3
• PA	4
• HA	5
• NP	1
• NA	5
• M	1
• NS	8

H5N1 is Breaking the "Rules"

- Direct transmission from wild birds to humans
- High lethality for waterfowl
- Transmission of influenza virus genes from domestic poultry to migratory waterfowl
- Transmission of viruses mainly via the respiratory route
- Increased thermal stability
- Extensive diversity in pathogenicity for waterfowl
- Transmission to felids
- Is highly pathogenic H5N1 endemic in wild waterfowl?

CONTINUED RAPID EVOLUTION

Acknowledgements

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Dr. Yi Guo, Mark Palmer, Leo Poon, H. M. Yoon, Honglin Chen, Influenza Research Group

Influenza Research Group, University of Toronto, Ontario, Canada

Ministry of Agriculture and Rural Affairs, Department

Dr. H. M. Yoon, National Institute of Health, Center for Infectious Diseases, Division of Field Epidemiology

Research University, Washington, D.C.

Dr. H. M. Yoon

Are We Prepared for Emerging Zoonoses?

Hiroshi Kida

Director, Research Center for Zoonosis Control
Professor, Graduate School of Veterinary Medicine
Hokkaido University
E-mail: kida@vetmed.hokudai.ac.jp



Recent outbreaks of highly pathogenic avian influenza have spread worldwide. This H5N1 virus has jumped the species barrier and caused severe disease with high mortality in humans. A concern is that only the H5N1 virus is assumed to cause next pandemic in humans. Since each of the subtypes of influenza viruses perpetuates among migratory ducks and their nesting lake water in nature and avian viruses of any subtype can contribute genes in the generation of reassortants in pig, none of the 15 HA and 9 NA subtypes can be ruled out as potential candidates for future pandemic strains.

We have carried out global surveillance study of avian influenza and influenza virus isolates of 49 combinations of HA and NA subtypes have been isolated from fecal samples of ducks. So far, 76 other combinations have been generated by the genetic reassortment procedure in chicken embryos. Thus, avian influenza viruses of 125 combinations of HA and NA subtypes have been stocked for vaccine strain candidates and diagnostic use. Their pathogenicity, antigenicity, genetic information and yield in chicken embryo have been analyzed and registered in the database.



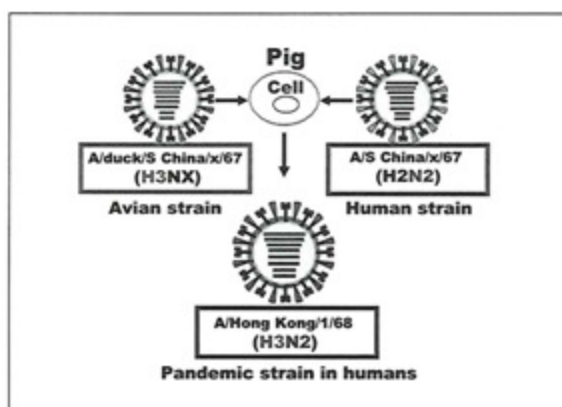
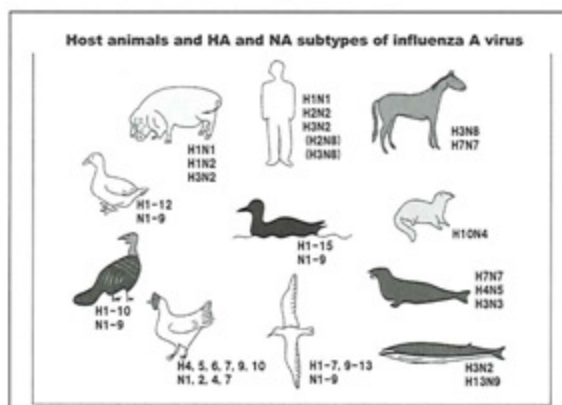
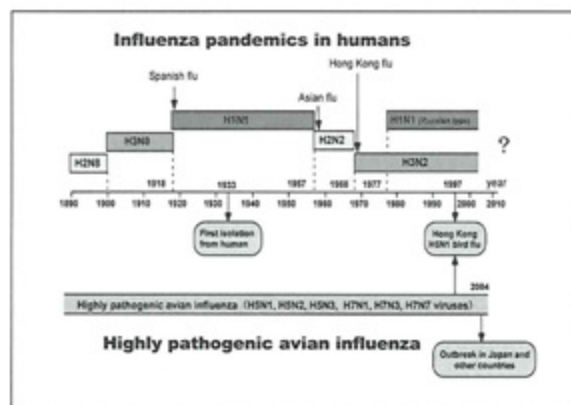
On the basis of the strategy for the control of influenza, Hokkaido University has established "Research Center for Zoonosis Control" in 2005. The long term goals of the center are the prevention and control of emerging zoonoses. To achieve the goals, the aims of the present program are; 1) to elucidate the ecology of zoonotic pathogens, 2) to detect the reservoir host and the route of transmission of each pathogen, 3) define the gene sequences that permit interspecies transmission of agents among animals including humans, 4) to clarify the molecular basis of pathogenicity of each agent for each of animal species, 5) to

develop rapid methods for diagnosis of zoonoses and detection of the agents, 6) to establish international networks for global surveillance of zoonoses, 7) to scheme contingency plans for the prevention and control of zoonoses, 8) to provide training courses for personnel who conduct control management at the sites of disease out breaks, 9) to exchange personnel between different laboratories in the world in order to develop new strategies for the control of zoonoses, and 10) to establish "International Collaboration Centers for Zoonosis Control" by 2008.

**Hokkaido University
International Symposium on
Sustainable Development**
August 7, 2006

**Are we prepared for
emerging zoonoses?**

HIROSHI KIDA
Hokkaido University
Research Center for Zoonosis Control
Graduate School of Veterinary Medicine



The role of pigs in the emergence of pandemic strains

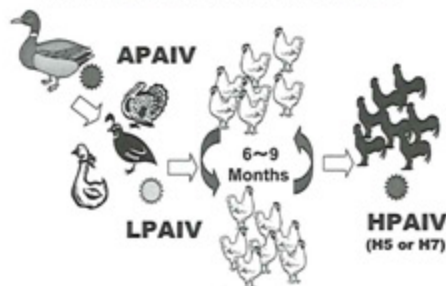
- ♦ Pigs are susceptible to avian influenza viruses of each of the HA subtypes.
- ♦ Genetic reassortants were generated in the cells lining upper respiratory tract of pig upon concurrent infection with mammalian and avian strains.

H. KIDA, Hokkaido University Graduate School of Veterinary Medicine

Tissue tropism of apathogenic, low pathogenic, and highly pathogenic avian influenza viruses in chicken

Virus strain	Virus infectivity (log ₁₀ EID ₅₀ /g)						
	Trachea	Lungs	Intestine	Kidney	Spleen	Brain	Muscle
Duck/Hok/2/99 (H5N2)	—	—	—	—	—	—	—
Chicken/Bj/2/97 (H9N2)	6.3	4.5	—	—	—	—	—

Acquisition of pathogenicity of avian influenza virus in chicken



Amino acid sequences at the cleavage sites of influenza A virus HAs

Subtype	Strains	Amino acid
H1	Dk/Alberta/35/76(H1N1) ^a	IQSR GLF
H2	Mal/MT/76/1(H2N2) ^a	IESR GLF
H3	Dk/Memphis/928/74(H3N8) ^a	KQTR GLF
H4	Dk/Czechoslovakia/56(H4N6) ^a	KASR GLF
H5	Ck/Scotland/59(H5N1) ^a	RKKR GLF
H5	Ty/MN/3/92(H5N2) ^a	RETR GLF
H5	Shw/Australia/1/72(H5N5) ^a	IETR GLF
H7	FPV/Rostock/34(H7N1) ^a	KKRKKR GLF
H7	Mal/Alberta/195/89(H7N3) ^a	KKTR GLF
H8	Ty/Ontario/6118/68(H8N4) ^a	VEPR GLF
H9	Ty/Wisconsin/66(H9N2) ^a	RSSR GLF
H10	Ck/Germany/N/49(H10N7) ^a	VQGR GLF
H11	Dk/England/56(H11N6) ^a	IASR GLF
H12	Dk/Alberta/60/76(H12N5) ^a	VQDR GLF
H13	Gl/Maryland/704/77(H13N6) ^a	ISNR GLF
H14	Mal/Gurjev/263/82(H14N5) ^a	KQAK GLF
H15	Shw/Australia/2576/79(H15N9) ^a	IRTR GLF

Senne et al, 1996^a, Kovacova et al, 2002^a

Pathogenicity of influenza virus for chicken

Cleavability of the HA protein into HA1 and HA2 is crucial and consecutive alignment of basic amino acids (R, K) at the cleavage site is related to the pathogenicity for chicken.

Cleavage activation of the HA occurs as a post-translational modification by an ubiquitous protease such as furin

- penetration by fusion into host cell
- extensive replication → systemic infection



HPAI outbreaks in Japan, 2004

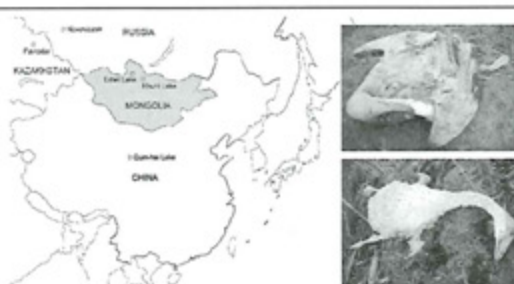


1	Yamaguchi Pref.	1/12/04	34,000 layers	HSN1	HPAI
2	Ohita Pref.	2/17/04	13 pet cks	HSN1	HPAI
3	Kyoto Pref.	2/28/04	225,325 layers	HSN1	HPAI
4	Kyoto Pref.	3/ 5/04	15,000 broilers	HSN1	HPAI

高病原性鳥インフルエンザの発生地(1995~2005年11月)

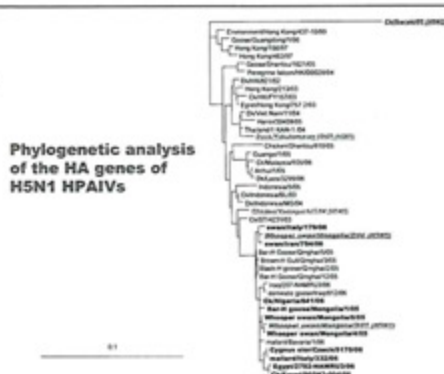
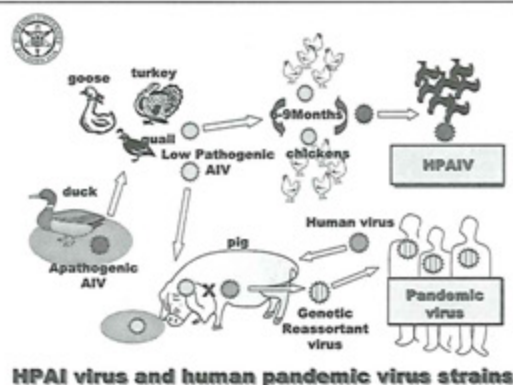
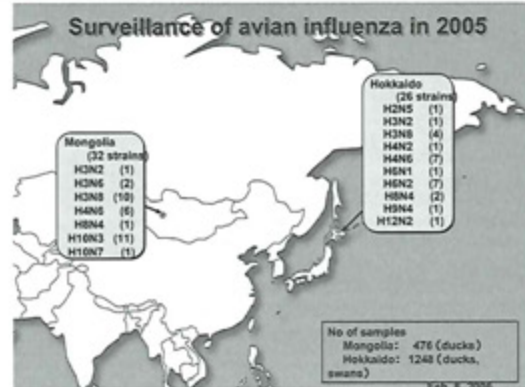


The diagram illustrates the evolutionary cycle of Influenza A Virus (IAV). It begins with wild waterfowl (represented by a duck) and Low Pathogenic Avian Influenza Virus (LPAIV) (represented by a turkey). An arrow indicates the virus moving from the turkey to a group of chickens, where it circulates for 6-9 months. From the chickens, an arrow points to a group of people, representing High Pathogenic Avian Influenza Virus (HPAIV) (H5 or H7). A curved arrow also points from the chickens back to the duck, suggesting a return to the wild. Virus particles are depicted at various stages of the cycle.



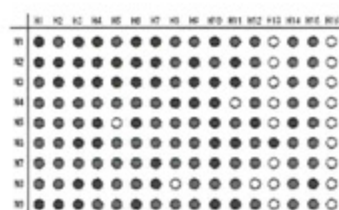
HPAI viruses in feral water birds, 2005

China: Whooper swans,
Bar-headed geese, etc
Hong Kong: Peregrine falcon,
Grey heron, etc
Croatia: Mute swans
Mongolia: Whooper swans,
Bar-headed geese
Romania: Swan, Heron
Kazakhstan: Geese, ducks

[illegible]

- ◆ H1 to H15 and N1 to N9 subtypes of Influenza A viruses are in ducks.
- ◆ 1957 H2N2 and 1968 H3N2 viruses are reassortants between avian viruses and the preceding human strains.
- ◆ The avian virus genes from the Eurasian gene pool are in southern China.
- ◆ Pigs are susceptible to avian influenza viruses and generate reassortants.
- Avian viruses of any subtype can contribute genes for reassortants.
- None of the 16 HA and 9 NA subtypes can be ruled out as potential candidates for future pandemics.
- Global surveillance of swine flu as well as avian flu

Present status of the library of vaccine strain candidates



Influenza viruses of 49 combinations of the HA and NA subtypes have been isolated from fecal samples of ducks in Alaska, Siberia, Mongolia, Taiwan, China, and Japan (black).

So far, 76 other combinations have been generated by genetic reassortment procedure in the lab (red).

Thus, avian influenza viruses of 123 combinations of HA and NA subtypes have been stocked as vaccine strain candidates. Their pathogenicity, antigenicity, genetic information and yield in chicken embryo have been analyzed, and being databased.

Program of Founding Research Centers Emerging and Reemerging Infectious Diseases

Research and Education for Zoonosis Control

Hokkaido University
Research Center for Zoonosis Control

Hiroshi Kida
Principal Investigator

Research and Development Model for Zoonosis Control



Hokkaido University Research Center for Zoonosis Control



Research Network



Points of Discussion

1. Ecology and evolution of influenza viruses: Natural reservoir, perpetuation, host range, interspecies transmission, antigenic and genetic variation of influenza viruses, and mechanism of the emergence of pandemic strains in humans and HPAIV in chickens
2. Do the H5N1 HPAIV strains perpetuate in the lakes where migratory birds nest?
3. Is the H5N1 HPAIV alone as a candidate of pandemic strain?
4. What is the best measure for the control of avian influenza?
5. Hokkaido University Research Center for Zoonosis Control

Summary of Plenary Session 3: Emerging Infections and Global Environment

Chaired by **Tsukasa Seya**

Professor
Graduate School of Medicine, Hokkaido University
E-mail: seya-tu@pop.med.hokudai.ac.jp



Speakers:

Robert G. Webster, Professor, Division of Virology, Department of Infectious Diseases,
St. Jude Children's Research Hospital, U.S.A.

Hiroshi Kida, Director, Research Center for Zoonosis Control, Hokkaido University

Drs. Kida and Webster mentioned influenza viruses with a variety of H/N combinations. This virus species possesses eight gene segments which are interchangeable in host cells during infection, some of them being virulent to human. The virus has many subtypes consisting of one of fifteen HA and one of nine NA. Some of these subtypes are potential candidates for future pandemic strains. In the case of H5N1 influenza viruses, ducks are playing a crucial role in the continued evolution and spread of this type of avian viruses. The viruses become non-pathogenic during adaptation in ducks but still highly pathogenic in poultry, ferrets, felids and humans. The immediate control of the spread of H5N1 could be achieved through the use of the antiviral neuraminidase inhibitors. Drs. Webster as well as Kida insisted on why vaccines against the viruses should be provided before possible pandemic influenza infection takes place. Dr. Kida introduced "Research Center for Zoonosis Control" founded in Hokkaido University on 2005. The goal of this center is to prevent emerging zoonoses, design vaccines for various influenza viruses and train specialists for control of zoonoses. The center provides the 10 arrays of the program for education of students and researchers. For more information, see the homepage of this center:

<http://www.hokudai.ac.jp/gakubu/zoonosiscontrol/index.html>.

Understanding and Approach to "Sustainability" Science of Fisheries

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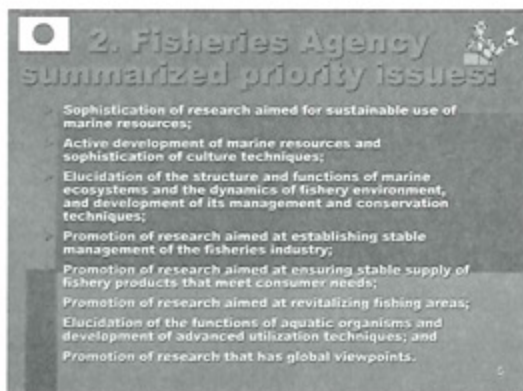
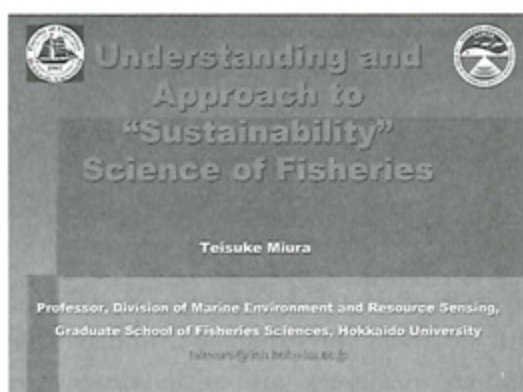
According to FAO's reports, currently, approximately 44% of key fish species are being exploited at their maximum, 16% are overexploited with no room for expansion, and 6% have been depleted. These figures show that world's aquatic resources are unsustainably, not sustainably, used. Japan imports approximately 40% of fishery products consumed in the country. Now, demand for marine products in Japan cannot be met without imports. The international community has started to see that Japan, a major importer of marine products, for example prawns and shrimps, has been indirectly facilitating the destruction of the environment in developing countries.

In these circumstances, how should we consider sustainable fisheries? Considerations that we need to make in considering global sustainability of Japan's marine-product supply are: ① the establishment of global supply system; ② the securing of stable supply and safety of imported fishery products; and ③ the establishment of partnership with importing countries. This paper, based on "Fisheries Research and Technical Development Strategy," a report that proposes new basic policies for fisheries of the 21st century, introduces the current status and problems of Japan's fisheries industry.

However, there is currently no clear definition of "sustainability of the fisheries industry." In this paper, I attempt to establish it logically. There are various ways to interpret the word "sustainability." Japan for Sustainability (JFS), for example, considers sustainability as from five basic compositions: ① Resource and Capacity, ② Fairness across Time, ③ Fairness across Space, ④ Diversity, and ⑤ Human Will and Networking.

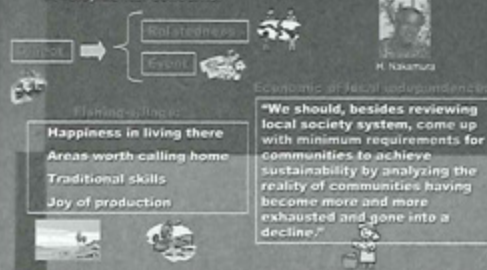


Based on this JFS's concept, the author first discusses sustainability of the fisheries industry and then examines the "sustainability" science of fisheries-theme of this lecture-more specifically, ①new logic of the "sustainability" science of fisheries, ②educational philosophy of the "sustainability" science of fisheries, and ③problems of the "sustainability" science of fisheries. Also, a framework for practice is proposed using concepts of "backcasting" and "benchmarking."



Meaning of "Sustainability":

Developmental concerns:



Seven items in relation to "Multifunctionality":

- Conservation of the natural environment and ecosystems;
- Securing the safety of the people;
- Preservation and creation of sound landscapes;
- Provision of places for leisure activities to the people;
- Passing-on of traditional cultures;
- Maintenance of local economy and society; and
- Food security.

Five basic compositions of JFS's "Sustainability":

- Resource and Capacity:** To live socially and economically satisfactory lives within limited global natural resources and carrying capacity, and consider a mind of appreciation and "MOTTAINAI (Waste Not, Want Not)";
- Intergenerational Justice:** To receive the inheritance of previous generation and pass it on to future generation correctly;
- Equitable Resource Space:** To distribute wealth, goods and resources between nations and regions in an equitable way, and there is no exploitation from one to another;
- Diversity:** To respect the diversity of individuals, species, culture, which is also of other organisms; and
- Human Will and Networking:** Individual's will to build a better society, networking through communication with others, flexible and open mutual dialogues and social participation.

The context of JFS's "Sustainability":

- Nature:** Natural, global and local environments including the concepts of resource capacity and biodiversity. A fundamental concept of sustainability;
- Economy:** Something which enriches human life and makes the life easier by providing goods and services. An economic activity in general;
- Society:** Social activity, government, school, community, etc. An aggregation of human life; and
- Well-being:** Individual's self-actualization, pursuit of happiness, social participation, and improvement of quality-of-life.

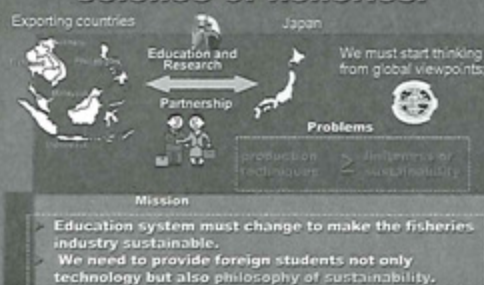
4. Education and research of sustainable fisheries:

- To adopt global principles
- To adopt universal logic
- To understand other academic field more deeply

New logic space of the science of fisheries:

	Fishing industry	Aquaculture	Marine biotechnology
Structure space			
Objectivity	Chaos	Pattern	Transformation
Subjectivity	Adaptation	Operation	Strategy
Practice	Self-preservation	Optimization	Learning
Functional space			
Cognition	Induction	Deduction	Abduction
Evaluation	Reliability	Efficiency	Plasticity
Direction	Management	Control	Creation
	Management space	Control space	Creative space

Philosophy of the science of fisheries:



5. Changes in sosioeconomy and Japanese soul:

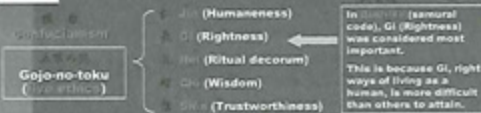
Postwar history:

- Japan had made miraculous advancement during the 20 years between around 1955 and the mid-1970s in pursuit of joining world's economic giants.
- The world, instead of praising the Japanese who achieved the rapid economic growth, despised them, calling them "economic animals."
- Carried away by the bubble economy which started in the late 1980s, Japanese people lost their innate incorruptible spirits and developed inconsistency and arrogance.
- Then, the bubble's implosion took away their emotional pillars and goals.

Japanese Spirituality:



Inazo Nitobe served as Undersecretary General of the League of Nations and is the author of "The Soul of Japan."



This is an all-time sense of values.

We, as those living in modern age, should ask ourselves anew the meaning of it.

I think that basis of all future educational, research and socioeconomic activities should have Gi (Rightness) in them.

With the emotional pillar, I will approach to specific individual problems.

6. Proposals to the fisheries and the scientists:

Specifically, exporting countries must consider the nature of export that takes into account food safety for Japanese people, production systems that do not damage the environment in their own countries, and sustainable resource utilization that considers global resource preservation.

Also, these must be something that improves the life of people in exporting countries and gives them hope.

Importing countries, should strive for local production of coastal resources for local consumption, normalization of nitrogen budget through trading, and overall, reduction of the consumption of material and energy.

Educate youth in developing countries, because it is also for the Japanese who rely 40% of marine products they consume on imports.

"Regional Development Brought About by the Sea":

hosted by the Science Council of Japan, was held in 2005 in Hakodate, Hokkaido.

President listed population growth (a problem in African nations), economic disparities between the North and the South, and environmental issues (global warming) as most pressing global issues.

He went on to suggest that a key to Japan's future is "to incorporate sustainability of the earth in values of all sciences and technologies".

The science of fisheries of the 21st century must have the context that it contributes to the sustainability of the earth from the academic field.



Fisheries subjects which we have to consider:



Is it possible to satisfy the growing demand in the fisheries industry and simultaneously lower its environmental impact?

What regional differences are important when considering the production system? Also, what is the contribution of each production system to the region?

What are the global trends relating to seafood? Can we draw up a solution strategy directed at these trends?

Can an evaluation technique be developed for measuring the extent of progress in the sustainability of the fisheries industry?

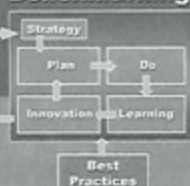
How do the global environmental changes caused by the fisheries industry affect regional policies? And can the design of production systems be altered to accommodate for these policies?

7. Framework for practice:

Backcasting



Benchmarking



Conclusions:

A sea area where healthy fisheries are operated is healthy, and it protects our living environment.

The fisheries industry is a key industry that supports life and the environment, wherein lies the ground for the whole society to support this industry.

Consequently sustainability of fisheries is of enormous importance to the human society.



Hokkaido University International Symposium on Sustainable Development

Plenary Session 4: Monday August 7, 2006 / 4:50pm-5:30pm

Speaker

Strategy towards Achievement of Sustainable Agriculture for Food, Energy and the Environment in the Age of the Globalization

Nasir El Bassam

Director

International Research Centre for Renewable Energy (IFEED),
Germany

President

International Council of Sustainable Agriculture (ICSA)

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Agriculture is the foundation of all cultures, economic advancement and human dignity. Also, Agenda 21 of the Rio de Janeiro Conference in 1992 put significant emphasis on agriculture as a key for intra-and intergenerational equity.

Today we face immense pressure in the global environment resulting from industrial emissions of greenhouse gases, the continual growth of the world population and the depletion of natural resources. The recognition of the necessity for actions and the intention and the will are vital evolutionary steps towards sustainability.

Food security is often undermined by factors such as water availability, land distribution, poverty, and environmental degradation. Among the major food security threats on the horizon are climate change, the loss of diversity of plant and animal species and the rise of food borne illnesses.



The key concept is to promote the conservation and the sustainable use of natural resources, which allows long term economic growth and enhancement of productive capacity, along with being equitable and environmentally acceptable.

In order to meet challenges, the future energy policies should put more emphasis on developing the potential of energy sources, which should form the foundation of future global energy structure. In this context, the FAO in support of the

Sustainable Rural Environment and Energy Network (SREN) has developed the concept of the Integrated Energy Farms for the optimization, evaluation, and implementation of sustainable food, water and energy production systems in rural communities.

(IR35), Sapporo, Hokkaido University, Japan, 7-9 August 2006

Strategy towards Achievement of Sustainable Agriculture for Food, Energy and the Environment in the Age of the Globalization

N. El Bassam

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Introduction

Sustainable development has been defined by the World Commission on Environment and Development in, "Our Common Future" (Brundtland, 1987) as a strategy that meets the needs of the present without compromising the ability of future generations to achieve their own requirements.

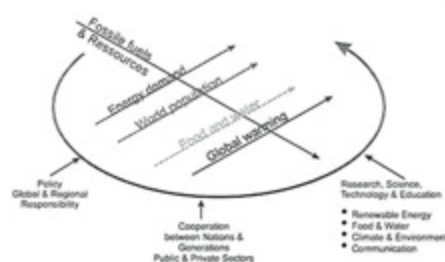
The key concept is to promote the conservation and the sustainable use of natural resources, which allows long term economic growth and enhancement of productive capacity, along with being equitable and environmentally acceptable.

Sustainable Development Systems (Gold, M.V., 1999)

Such systems must be:

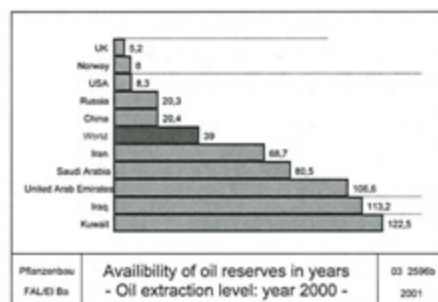
- "resource-conserving,
- socially supportive,
- commercially competitive,
- and environmentally sound"

Basic Reasons for unsustainable Development

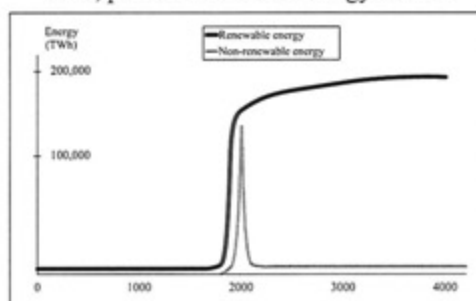


Energy, Environment and Development

1. Primary energy sources are limited and mainly non-renewable and not sustainable
2. Excessive use of fossil fuels causes serious damage to the environment and climate
3. The world, mainly the Developing Countries, is facing a period of uncertainty and changes – depopulation of rural regions and decreasing farmer's income



Past, present and future energy sources



World by Carbon Emissions



Environmental Performance Index (EPI)

Overall EPI scores(0-100)

Categories: Health, Biodiversity, Energy, Water, Air, Nat. Res.

Rank	Country	Score
1	New Zealand	88.6
2	Sweden	87.8
5	UK	85.6
9	Malaysia	83.3
14	Japan	81.9
20	Australia	80.1
22	Germany	79.4
28	USA	78.3
94	China	56.2
118	India	47.7
133	Niger	25.7

World Economic Forum 2006

India 2002



Germany 2002



Wildfire, Arizona, USA 2002



Residents depart as the late afternoon sun illuminates the smoke from the approaching Rader wildfire Saturday, June 22, 2002, in Show Low, Ariz. Rader and the Chuska wildfires have forced several communities in the area to evacuate.
(AP Photo/Ric Francis)

Agriculture is the foundation of all cultures, economic advancement and human dignity. Also, Agenda 21 of the Rio de Janeiro Conference in 1992 put significant emphasis on agriculture as a key for intra-and intergenerational equity

Availability of Basic Needs - Global Context-



- More than 2 billion people have no access to modern energy resources
- More than 800 million suffer from hunger and malnutrition in Africa, Asia, Latin America and even in Europe and USA
- One and half billion people suffer from a shortage or inadequate supply of water
- Current policies could lead the increasing conflicts over scarce resources (energy, water and food)

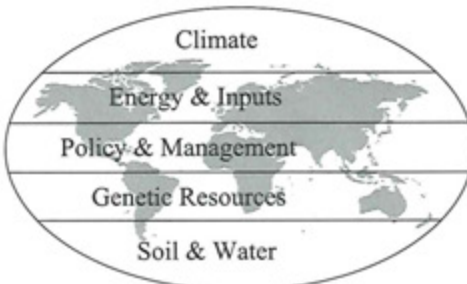
Poverty is rural

- 2.8 billions of employees earn less than 2 US\$ per day
- 1,4 billions of the employees earn less than 1 US\$ per day
- Only 300 persons possess more than 3 billions of the world population
- Most of poor peoples are living in rural regions
(Davos 2006)

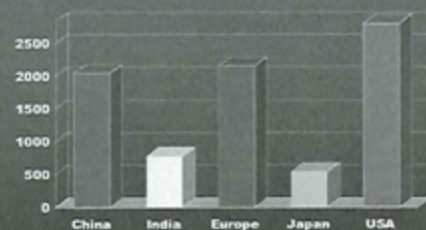
World's poorest people suffer the most because:

- Their narrow margin of survival
- Lack of access to technologies
- Vulnerability to natural hazards and
- Fragility of the ecosystems in which they are concentrated

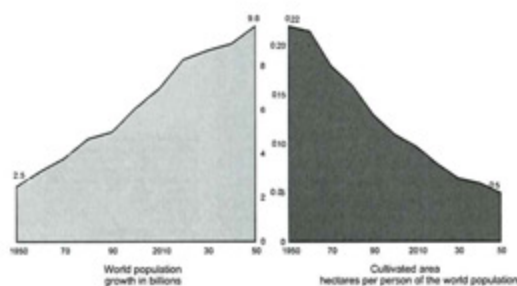
Fundamentals of sustainability in agriculture



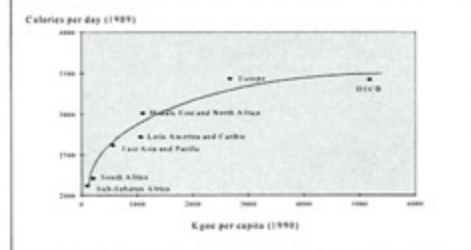
Ecological Footprint 2004 (million global hectares)



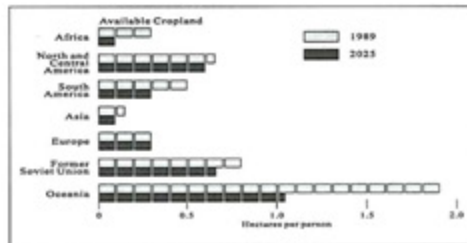
World population growth and respective per capita cultivated area from 1950-2050 (source: Future, 1998).



Correlation between energy input and availability of food as calorie supply (FAO, 1995)



Cropland per person in the year 1989 and estimated for 2025 (World Resource Institute, 1990)

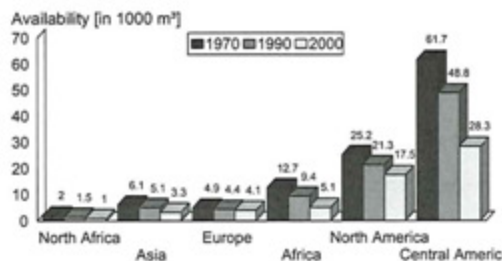


Global Water Availability

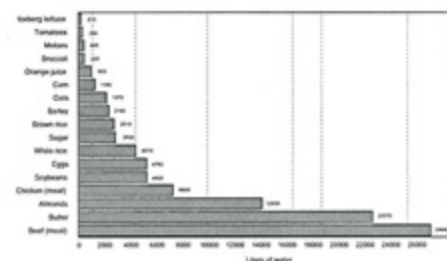
1) Approximately 3% of the world water resources are freshwater. Only 0,69% is available for human needs

2. Huge differences exist in water requirements for the different food production chains (water use efficiency)

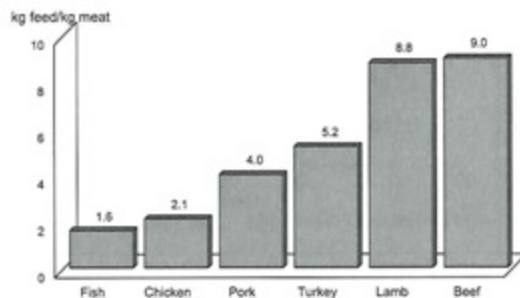
Water availability p.p. in selected areas in the years 1970, 1990 and estimated for 2000 (source: FAO).



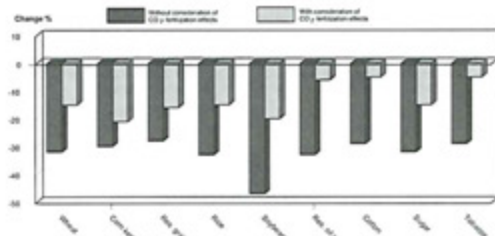
The amount of water in liters necessary to produce one kilogram of food (Water Education Foundation)



Feed requirements for meat production (source: Future, 1998).



Global yield changes of plant products with and without consideration of CO₂ - fertilizer effects



Global Biomass for Food, Energy and Energy & Perspectives

- Annual primary biomass production: 220 billions DM, 4,500 EJ = 10 times of world primary energy consumption.
Biomass used for food: 800 millions DM = 0,4% of primary biomass production.
- Annual food production corresponds to 140% of the needs of world population.
- Biomass currently supplies 14% of the worldwide energy consumption. The level varies from 90% in countries such as Nepal, 45% in India, 28% in China and Brazil with conversion efficiency of less than 10%. The potential of improving this efficiency through novel technologies is very high.
- Large areas of surplus of agricultural in USA, EU, East Europe and former soviet countries and could become significant biomass producing areas (> 200 millions ha).

- Microalgae have the potential to achieve a greater level of photosynthetic efficiency than most other forms of plant life. If laboratory production can be effectively scaled up to commercial quantities levels of up to 200 mt/ha/yr may be obtained.
- The efficiency of photosynthesis is less than 1%. An increase in this efficiency (through genetic engineering) would have spectacular effects in biomass productivity: successful transformation of C₃-mechanism (from maize) to C₄-crops (rice). New achievement in accelerating cell division opens opportunities to speed up the growing seasons, resulting in several harvests per year and an overall increase in biomass.
- Developments in car technologies is leading to significant reduction in fuel consumption, i.e. less areas will be needed for more cars.

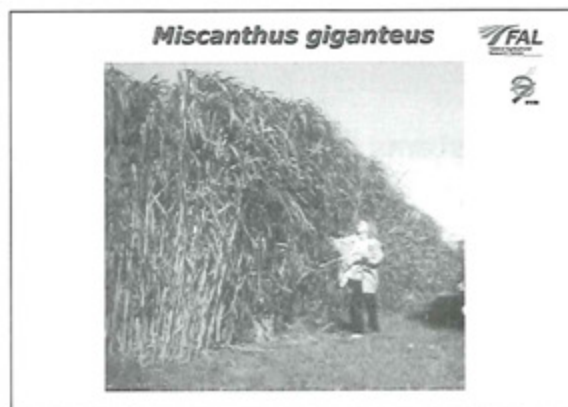
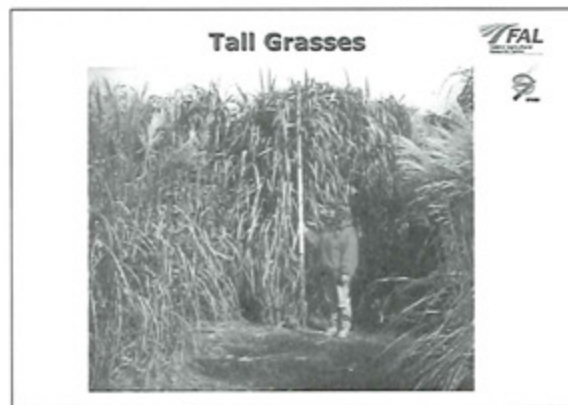
Possible Share of Renewable Energy Sources in Various Climatic Zones - Farm Activities -					
Climatic Region	Energy source	Power production (% of total need)	Heat production (% of total need)	Biomass used (t/ha)	Biomass area (% of total area)
North and Central Europe	Solar	100	12	-	-
	Wind	-	-	-	-
South Europe	Biomass	100	100	100	100
	Solar	12.7	40	-	-
North Africa Subarctic	Wind	100	-	-	-
	Biomass	70	65	30	4.8
Equatorial region	Solar	20	90	-	-
	Wind	70	-	-	-
	Biomass	20	20	14	1.2
	Solar	14.2	20.5	-	-
	Wind	40	-	-	-
	Biomass	70	80	45	10

Biomass for Food, Energy and the Environment

Representative Energy Plant Species for different climate regions - Tropical and Subtropical Climate -					
- Alekan Grass (<i>Echinochloa polystachya</i>) - Bahama palm (<i>Orbipya oleifera</i>) - Bamboo (<i>Bambusa spp.</i>) - Banana (<i>Musa x paradisiaca</i>) - Black locust (<i>Rubinia pseudacacia</i>) - Brown beetle grass (<i>Lepidochloa fuscus</i>) - Canava (<i>Manihot esculenta</i>) - Cassia oil plant (<i>Ricinus communis</i>) - Coconut palm (<i>Coccol nucifera</i>) - Eucalyptus (<i>Eucalyptus spp.</i>)	- Jatropha (<i>Jatropha curcas</i>) - Jute (<i>Crucora spp.</i>) - Leucaena (<i>Leucaena leucocephala</i>) - Nylon tree (<i>Asiadrachma indica</i>) - Oil palm (<i>Elaeis guineensis</i>) - Papaya (<i>Carica papaya</i>) - Rubber tree (<i>Acacia senegal</i>) - Sisal (<i>Agave sisalana</i>) - Sorghum (<i>Sorghum bicolor</i>) - Soybean (<i>Glycine max</i>) - Sugar cane (<i>Saccharum officinarum</i>)	Planzenbau FAL/EI Ba 2000			

Representative Energy Plant Species for different climate regions - Arid and Semiarid Climate -					
- Argan tree (<i>Argania spinosa</i>) - Broom (<i>Ginebra</i>) (<i>Spartium junceum</i>) - Cardoon (<i>Cynara cardunculus</i>) - Date palm (<i>Phoenix dactylifera</i>) - Eucalyptus (<i>Eucalyptus spp.</i>) - Giant reed (<i>Arundo donax</i>) - Groundnut (<i>Arachis hypogaea</i>) - Jajoba (<i>Simmondsia chinensis</i>)	- Olive (<i>Olea europaea</i>) - Poplar (<i>Populus spp.</i>) - Rape (<i>Brassica napus</i>) - Safflower (<i>Carthamus tinctorius</i>) - Salicornia (<i>Salicornia bigelovii</i>) - Sesbania (<i>Sesbania spp.</i>) - Soybean (<i>Glycine max</i>) - Sweet sorghum (<i>Sorghum bicolor</i>)	Planzenbau FAL/EI Ba 2000			

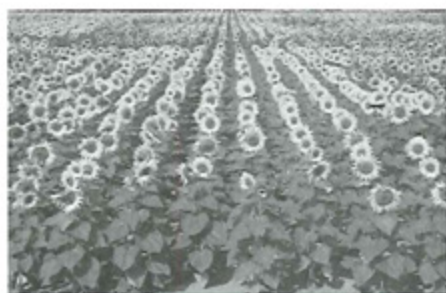
Representative Energy Plant Species for different climate regions - Temperate Climate -					
- Cordgrass (<i>Spartina spp.</i>) - Fibre sorghum (<i>Sorghum bicolor</i>) - Giant knotweed (<i>Polygonum sachalinensis</i>) - Hemp (<i>Cannabis sativa</i>) - Knap (<i>Mibiscus cannabifolius</i>) - Linseed (<i>Linum usitatissimum</i>) - Miscanthus (<i>Miscanthus x giganteus</i>) - Poplar (<i>Populus spp.</i>) - Rape (<i>Brassica napus</i>)	- Reed Canary Grass (<i>Phalaris arundinacea</i>) - Rosin weed (<i>Silphium perfoliatum</i>) - Safflower (<i>Carthamus tinctorius</i>) - Soy bean (<i>Glycine max</i>) - Sugar beet (<i>Beta vulgaris</i>) - Sunflower (<i>Helianthus annuus</i>) - Switchgrass (<i>Panicum virgatum</i>) - Topinambur (<i>Helianthus tuberosus</i>) - Willow (<i>Salix spp.</i>)	Planzenbau FAL/EI Ba 2000			



Arundo donax



Fibre and Sweet Sorghum



Bamboo



**Biodiversity is an Economical
Necessity for Cultivated Forests
(South America)**



Micro Algae Cultivation



**Systems and Technologies
for Farms and Communities**

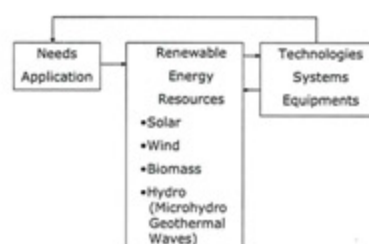
Introduction of Renewable Energy to Rural Regions

- Key Issues -

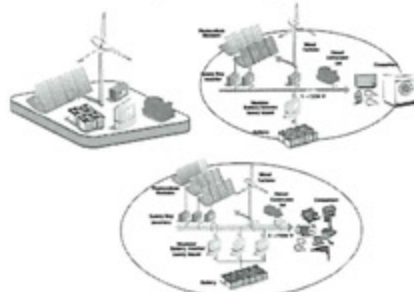
- Appropriate policy (Intention for Development)
- Availability
- Accessibility
- Acceptability
- Affordability



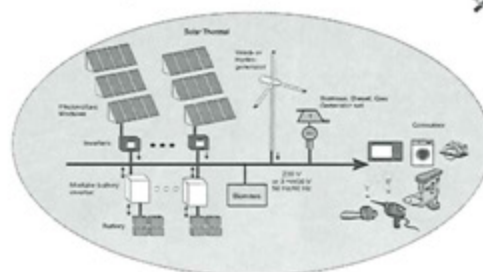
Procedure of Energy Supply



Main components of an PV Hybrid System, a single-phase island grid, and three phase island grid



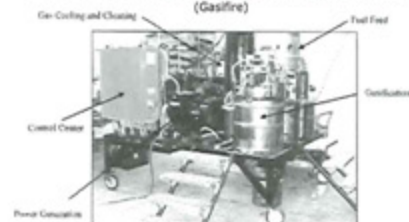
Renewable Energy Technologies - System Integration -



Mobile Power Generator (Solar, Wind, Bio-Diesel)



12.1/2 kW Small Modular Biopower System - Endurance Test Unit (Gasfire)

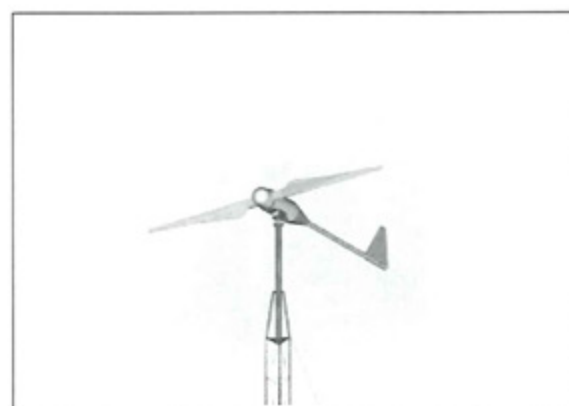
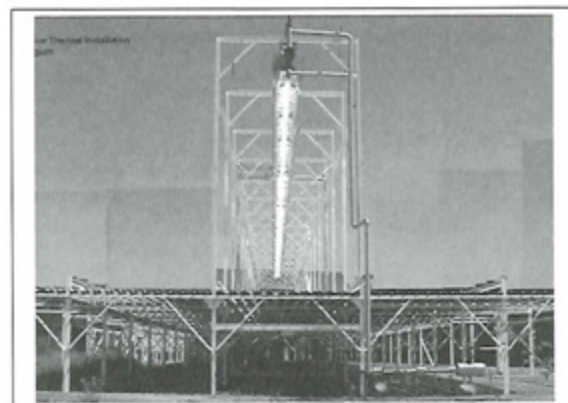
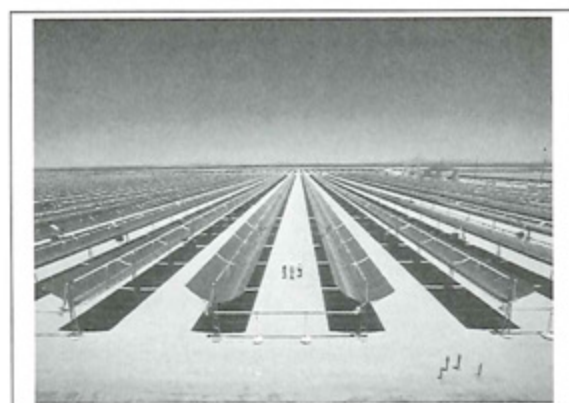
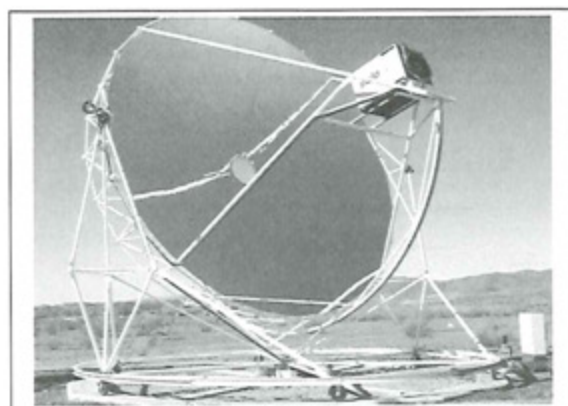
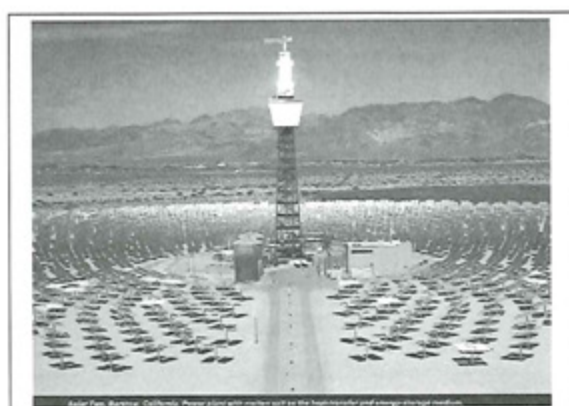


Micro Solar Thermal Power Generator



Solar Parabol Power Generator





Solar Street Lantern



Solare Straßenbeleuchtung



Communication





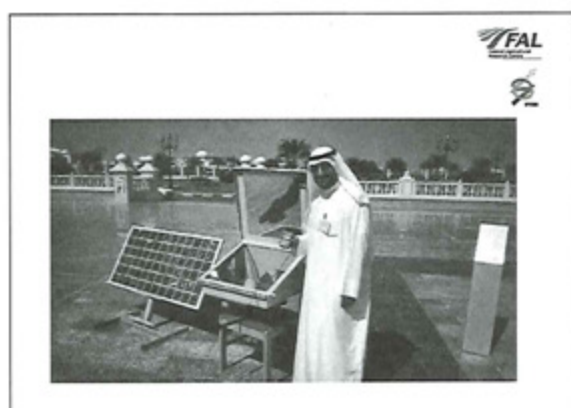
ISAAK™ Solar Icemaker Demonstration











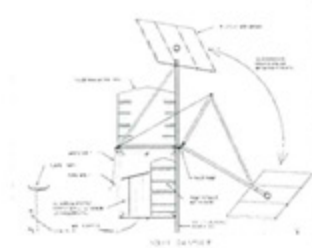
Biomass – Universal – Stove Turbo-Stove BAFOB 5 KW



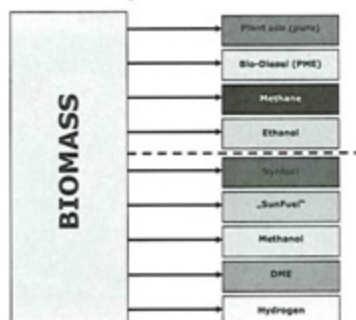
Multifunctional Stove
for Cooking, Baking,
Roasting, Barbecue and
Heating



The Solarflow System for Water Pumping and Purification



Transport Fuels



Ölfelder des 21. Jahrhunderts



-Oilfields of the 21st century-

VW Lupo3L



Aktuelle Aktivitäten der Automobilindustrie.



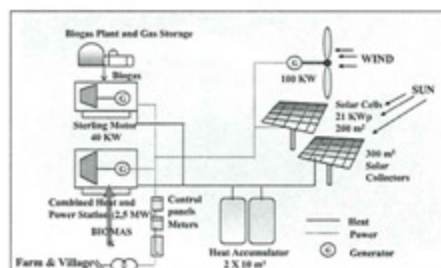
LH: Longitudinal

CGH₂₅ regulated Lysine, HistidineV 200
2000 PWiley
2008

Energy Supply: 100% Biomass = 100% Renewable



1 Thermal and Power unit (Biomass, Wind, Solar) 2 Pelleting, Oil mill, Ethanol unit
3 Animal husbandry 4 House unit 5 Administration



Desert Renewable Energy Farm



Project Adolhpshof, Germany



Conclutions

Dialogue, cooperation and research are the tools to overcome the major challenges of humanity and to ensure the sustainability for current and future generations.

new developments and technologies supporting sustainable systems should be transferred to the end users ensuring linkage between basic research and applications.

We as must bear the responsibility to understand the earth as an integrated whole.

We have to evaluate the impacts of our actions on the global environment in order to ensure sustainability and to avoid future disruption to natural life cycles.

We are one earth, one humanity and one future. We have to change our way of thinking from:

"I, HERE and NOW" to:

"WE, EVERYWHERE for TODAY and TOMORROW".

Finally, it is our responsibility to foster public education and outreach programs to promote awareness of ecological, biological and organic production systems at all levels of society.

We should act now while we still have the choices

Global Economic Powers (Davos 2006)



1. USA
2. Japan
3. Germany
4. China
5. France

Publications:

- *Energy Plant Species- Their Applications and Impact on Environment and Development. James&James Science Publishers, 1998*
- *Integrated Renewable Energy for Rural Communities- Planning Guidelines, Technologies and Implementation. Elsevier Publishers, 2004*

“When things are investigated, the knowledge is extended.

When knowledge is extended, the will becomes sincere .

When the will is sincere, the mind is correct.

When the mind is correct, the self is cultivated.”

Confucius

Thanks to the Hokkaido University!



Thank you for your attention !

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The Sustainability of Bio-production Systems

Mitsuru Osaki

Director, Sustainability Governance Project, Hokkaido University
Professor, Research Faculty of Agriculture, Hokkaido University
E-mail: mosaki@chem.agr.hokudai.ac.jp



The present high productivity levels enjoyed by modern agronomy have largely been attained through intensive land management practices such as the vigorous application of fertilizers, fungicides, pesticides and herbicides, improved tillage and irrigation techniques, mono cropping, mechanization, and so on. However, these activities are becoming increasingly difficult to sustain due to 1) soil degradation and environmental pollution, 2) reduced oil production, and 3) climate changes. In this paper, I would like to discuss how to guarantee the sustainable development of human societies by proposing new biomass production fields, for which highly detailed models must be constructed via a systems simulation approach, and by developing sustainable cultivation methods as follows.



(a) Development of integrated and detailed models for sustainable biomass production: There are three compelling reasons why such detailed models are necessary for achieving sustainability. The first is to integrate the fragmented pieces of knowledge we have accumulated so far. The second is the process of establishing goals - namely, how the systems models may contribute heuristically. The third is using model simulations to evaluate levels of sustainability. Highly detailed models of food and biomass production systems must involve every activity related to the production and utilization of biomass, namely rhizosphere and phytosphere control, pest and disease management, ways of utilizing unavailable and/or wasted biomass, pollution monitoring, economic issues, and so on.

(b) Development of monitoring and risk management systems for food production fields: We are currently facing several important problems brought about by highly developed technology. Severe problems with residual chemicals and the flow of pesticides and chemical

fertilizers exist in both agricultural and natural systems. For these reasons, we need to develop new monitoring systems and provide the governance to regulate them.

The Sustainability of Bio-production Systems



Mitsuru OSAKI, PhD
Director of Sustainability Governance Project of Hokkaido University
Prof. of Research Faculty of Agriculture & Graduate School of Agriculture

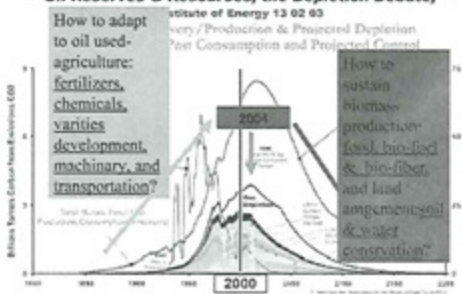


Is oil-based agriculture sustainable?

One to two hour/ha
(Rice cultivation: 30 days/ha in Japan)

Oil production and CO₂ emission

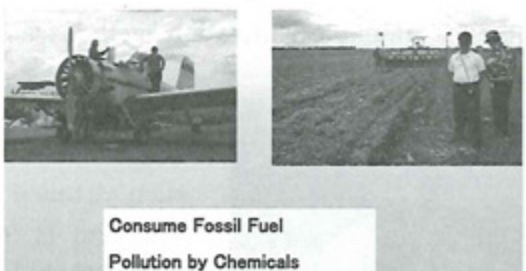
"Oil Reserves & Resources, the Depletion Debate,"
Institute of Energy 13 02 03
Very / Production & Projected Depletion
Fast Consumption and Projected Control



How to adapt to oil used-agriculture: fertilizers, chemicals, varieties, development, machinery, and transportation?

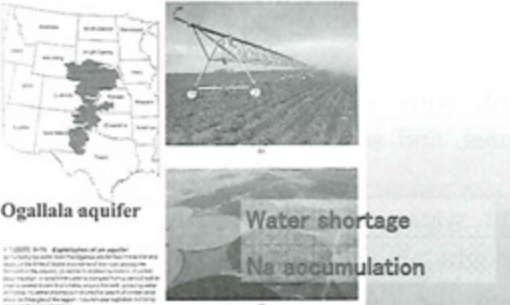
How to sustain biomass production: food, bio-fiber, and bio-fiber, and land management: soil & water conservation?

Environmental Problems in oil-used agriculture?



Consume Fossil Fuel
Pollution by Chemicals

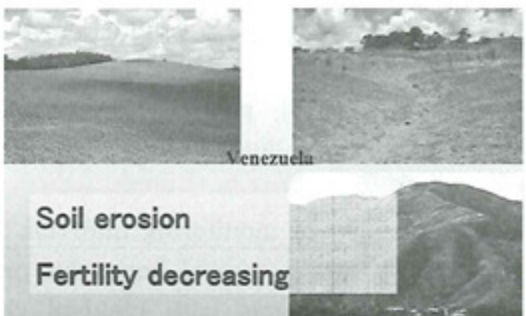
Water problems ?



Ogallala aquifer

Water shortage
Na accumulation

Soil Problems?



Venezuela

Soil erosion
Fertility decreasing

Degradation of forestry and soil

Carbon in Vegetation: 262-880 Gt

Carbon in Soil: 951-1,555 Gt



World Resources 2000-2001, ELSEVIER SCIENCE 2000

Degree of Carbon Storage in Soil

Carbon in Vegetation: 262-880 Gt

Carbon in Soil: 951-1,555 Gt

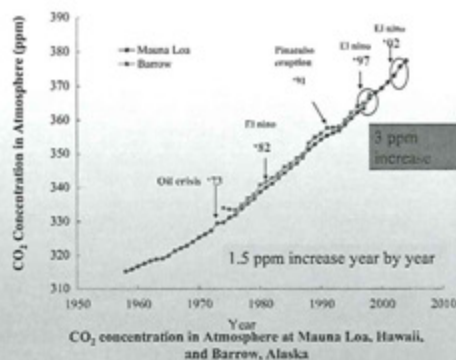


World Resources 2000-2001, ELSEVIER SCIENCE 2000

Wild fire spot in Southeast Asia in 1997

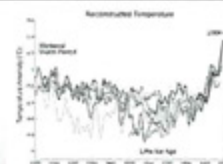


Wild fire spot in Siberia in 2003



1000 Year Temperature Comparison

Hockey stick shape



Reconstructed temperature from 1000 AD to 1990 AD. The graph shows a sharp increase in temperature starting around 1850 AD, which is consistent with the 'hockey stick' shape. The data is based on a combination of instrumental data and tree-ring data.

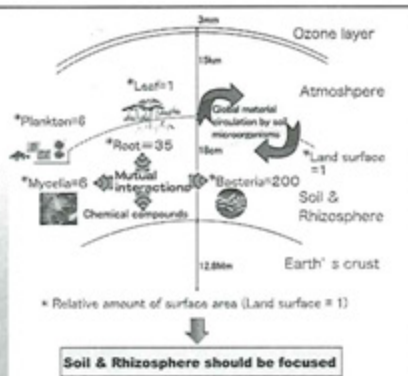
Environmental/Ecological
Catastrophic Phase!

SOILS The Final Frontier Science

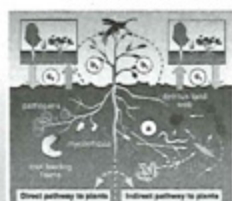
Soil is most
important
factor for
sustainable
agriculture



What is Metabolic Driving Forces in Earth?



Plant & Soil Interaction

[illegible]

2004
International Congress
RHIZOSPHERE
Rhizosphere and Microbiology
in a World in Crisis



Hilner 1862-1923

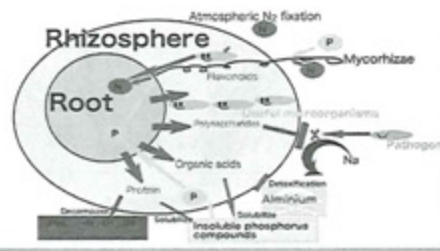
Hiltner, L. (1904): Unsere Erfahrungen mit dem Problem auf dem Gebiet der Bodenbakteriologie und unter besonderer Berücksichtigung der Gründüngung und Brauerei. Abh. Dtsch. Landwirtschaft. Ges., 59: 75. (in German)

- origin: Rhiza (root) + Sphere (One's field of action, influence, or existence.)
- Simplest
It is that the region influenced by the root.
- Area
Ordinary: A few millimeters from rhizoplane.
Extreme case: A few centimeters from rhizoplane.

What is Rhizosphere regulation ?

Strategy I: Root exudation

Strategy II: Symbiosis with microorganisms



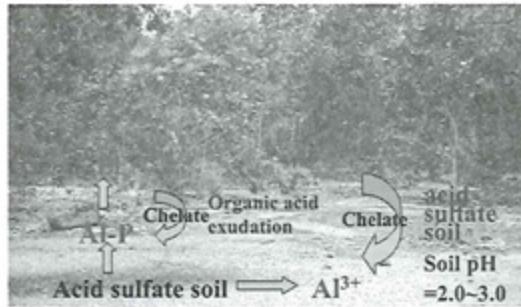
Why can not rhizosphere study develop ?

Soil is black box.

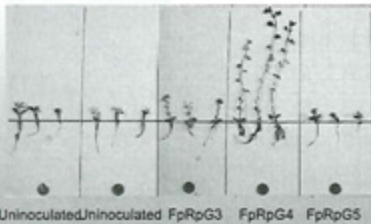
Why?

- Microorganisms number in soil 10^{10} /soil 1g
- Possibility of isolation, cultivation, and identification: less than 1 %
- Chemical species in soil: more than 10,000

Strategy I: Root exudation
Organic acids exudation



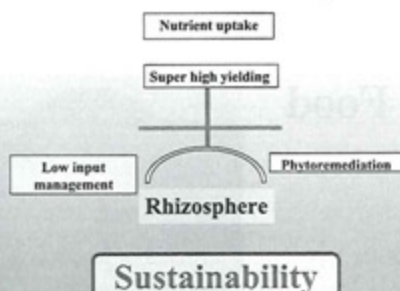
Strategy II: Symbiosis with microorganisms
Some *Burkholderia* isolates can utilize phytate



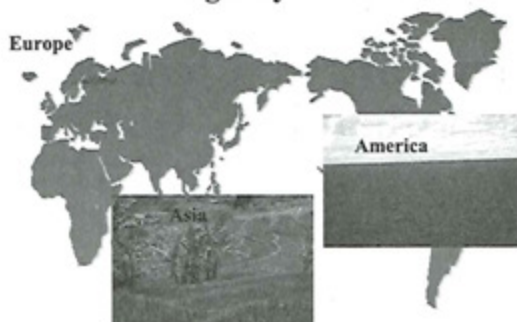
Matrix for microorganisms:
Charcoal



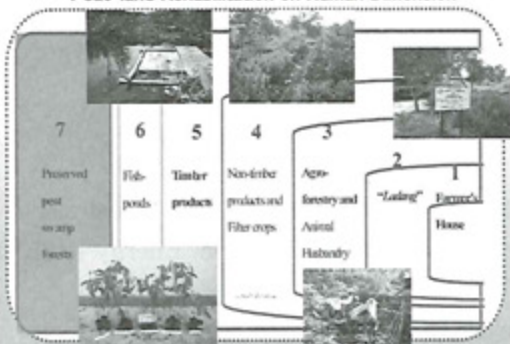
Function on Rhizosphere



Agro-system



Peat-land Rehabilitation on Human Dimension



GLOBAL LAND PROJECT DRAFT SCIENCE PLAN

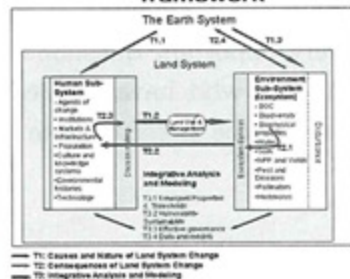
GLOBAL LAND PROJECT (GLP)



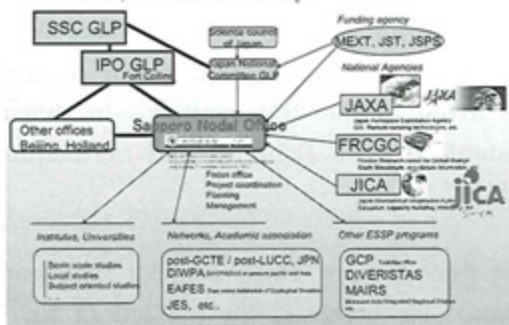
Regional Office
in Hokkaido University

PROPOSED TO
IGBP AND IHDP
INTEGRATED GCTE AND LUCC
RESEARCH ACTIVITIES

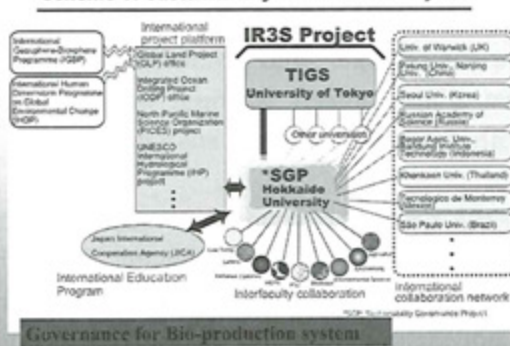
Global Land Project conceptual framework



Sapporo Nodal Office of GLP: its roles "Vulnerability, resilience, and sustainability"



Scheme of Sustainability Governance Project



Thank you for your attention!



Summary of Plenary Session 4: Sustainability Governance on Food and Bio-resources

Chaired by **Yutaka Saito**

Deputy-Director
Sustainability Governance Project (SGP),
Hokkaido University
E-mail: yutsat@res.agr.hokudai.ac.jp



Speakers:

Teisuke Miura, Professor, Graduate School of Fisheries Sciences, Hokkaido University
Nasir El Bassam, Director, International Research Centre for Renewable Energy (IFEED), Germany
Mitsuru Osaki, Director, Sustainability Governance Project (SGP), Hokkaido University

Can we maintain our present lifestyles for the next 50-100 years to come? What will become of our resources, food and environment if society continues its present practices of mass production, mass consumption and mass disposal? These are very important questions for people living in the 21st century. In this section, three researchers who have studied on the sustainability of fisheries and agriculture were invited to review the present state of these fields.

The first speaker, Prof. Teisuke Miura addressed several current problems facing fisheries in Japan. He accessed the amount of fish imported into Japan from many countries and discussed how we must focus more attention on conserving the fisheries resources of exporting countries. Furthermore, the shrimp culturing that has resulted from strong Japanese demand has lead to poverty and the coastal destruction of many South East Asian countries. He proposed that by making the fisheries industry more sustainable, such problems could be resolved. To do this however, education systems must adapt, namely we need to provide foreign students not only with technology, but also with the philosophy of sustainability.

The second speaker, Prof. N. El Bassam addressed the necessity of new bio-resource industries as a strategy that can meet the needs of the present without compromising the ability of future generations to achieve their own requirements. He said that primary energy sources are limited and mainly non-renewable and not sustainable. Furthermore, the world,

primarily developing countries, is facing a period of uncertainty and change - depopulation of rural regions and decreasing farmer incomes. Thus, he concluded it is our responsibility to foster public education and outreach programs to promote awareness of ecological, biological and organic production systems at all levels of society.

The last speaker, Prof. Mitsuru Osaki discussed the importance of carbon storage in soils, and outlined the seriousness of wild fires in the peat lands of South-east Asia and Siberia. Furthermore, he advocated the importance of the soil rhizosphere for sustainable agriculture, and how further researches in this field will advance safe agriculture without the need for chemical fertilizers. In addition, he introduced the purpose of the Hokkaido University Sustainability Governance Project and Global Land Project, both of which were established to create "sustainability sciences".