truss network will be developed. Here, mesoscopic damage is related to water and temperature change in concrete based on microscopic structure. At the fourth step, both the analytical systems will be combined, and then deterioration of concrete under combined action of fatigue and freezing-thawing can be simulated. Lastly, fatigue life prediction formula, which can take frost damage into account, will be developed for design purposes.

Macroscopic deformational model under fatigue loads (STEP1)

Fatigue loading tests were carried out and they were analyzed with previous experimental data. This activity corresponds to the first step. As a result of summarizing and organizing the experimental data, it was found that concrete under fatigue loading has non-damaging strain as well as damaging strain. Besides, stress-strain model was developed, and then deformation of concrete under fatigue loading could be numerically expressed. However, remaining issue was found, which is, amount of time-dependent plastic strain has not been quantitatively expressed under macroscopic level.

Time-dependent analysis of mortar by RBSM (STEP2)

Time-dependent analyses of mortars by RBSM were carried out as a basic study of fatigue analysis. In general, there are two visco-elastic models, which are Maxwell and Voigt model. In this study, characteristic of each model on results of RBSM analysis were examined through mortar analyses. Consequently, differences of strength and stiffness change from static case between Maxwell and Voigt model were found.

Keywords: concrete structures, life-prediction, fatigue, freezing-thawing, combined action, mesoscopic analysis

P-48

Fate of Pharmaceuticals in Human Excrement During the Composting Process of Feces

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We have proposed the Onsite Wastewater Differentiable Treatment System. In this system, household wastewater is separated into three fractions (blackwater, higher load graywater, and lower load graywater), and each is treated separately. The blackwater that may contain pharmaceuticals (PhACs) is treated by a composting toilet using sawdust as a matrix. Our objective in this study is to understand the fate of PhACs in the composting process varying the feces loading ratio on the toilet reactor. The variation of oxygen utilization rate (OUR) indicated the degradation rate of feces in the composting process, and the OUR profiles showed that feces were almost treated in early stage of this process. We also observed the decay of the selected PhACs in this process. The reduction profiles imply that the degradation of PhACs has small relation to the treatment of feces. The degradation rates of all PhACs were almost the same if the feces loading ratio was 5%, and the degradation rates of acidic PhACs were almost the same regardless of the increasing of the feces loading ratio. But the higher feces loading ratio gave higher degradation rates of basic PhACs. During the process higher feces loading ratio gave the higher ammonia concentration in the sawdust matrices and this resulted in higher pH value. In this experiment, the pH ranged from pH7 to pH9 and in this pH range, acidic PhACs are present as an ionic form. At pH 7, the basic PhACs exists as an ionic form, but at pH 8.5 and 8.8, where we observed the rapid degradation of the basic PhACs, about 10% of the basic PhACs exists as non-ionic form. Therefore we infer that the degradation of the selected PhACs is affected by the dissociation condition. To conclude this study, we obtained following knowledge; (1)Easily biodegradable organic matter (like feces) does not interfere the degradation of the PhACs; (2)The structural difference among the selected PhACs in this study gives insignificant effect on the degradation rate; (3)The dissociation condition may have a significant effect on the degradation rates in the composting process.

Keywords: Composting process, Degradation of Pharmaceuticals, Treatment at source

P-49

Simultaneous Power Production and Wastewater Treatment Using a Microbial Fuel Cell

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A microbial fuel cell (MFC) converts chemical energy, available in a bio-convertible substrate, directly into electricity. To achieve this, bacterial are used as a catalyst to convert substrate into electrons. Electrons are transferred through an external circuit while the protons diffuse through the solution to the cathode, where electrons combine with protons and oxygen to form water. The objective of this study is to optimize the operation conditions of MFC for simultaneous power production and wastewater treatment.

In this work, the MFC comprised anode and cathode chambers. Between the compartments, a Nafion proton exchange membrane was installed. Glucose (5 mM) was used as carbon source and loading rate was 2.0 ml/min. Electrodes of anode and cathode were consisted of woven graphite. The anode was continuously purged with nitrogen gas to maintain anaerobic condition, while the cathode was sparged with air. Current (I) was calculated at a resistance (R) from the voltage (V) as I=V/R. Power was calculated as P=IV.

Power generation was measured using a series of resistors (1-100000 Ω) to determine the maximum power output as a function of current. The highest power density of 5.0 mW/m2 was achieved at the current density of 23.5-26.0 mA/m2, which was obtained with the resistance of 900 and 800 Ω, respectively. The maximum coulombic efficiency was 11.6 % with a resistance of 500 Ω. The DOC removal rate was 30%. These results suggested the possibility of using MFC to generate electricity and simultaneously treat wastewater, but further progresses in the design and operation of MFC are required in order to accomplish greater overall MFC performance.

Keywords: microbial fuel cell, power density, current density, coulombic efficiency

P-50

Complexation Reactions of Anions on Hydrotalcite Surface

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Hydrotalcite is one of the naturally occurring minerals with a formula of [Mg1-xAlx(OH)2] [An-x/n·yH2O]. An- denotes an anion of which the valence is n. It comprises positively charged brucite-like octahedral layers and interlayers filled with anions and water molecules. The positive charge in the octahedral layers is formed by partial substitution of Al3+ for Mg2+. Stacking of the layers occurs and the balancing interlayer anions can be exchanged.

Recently, hydrotalcite has received considerable attention in a variety of fields because of their considerable anion-exchange capacity. It has been used as a sorbent in the removal of various pollutants in aqueous solutions. The mechanism involved has not yet been elucidated specifically surface complexation reactions. This study focuses on anion sorption mechanism in hydrotalcite with a specific regard on surface complexation reactions.

Chloride, nitrate, carbonate, sulfate, phosphate and silicate ions are the sorbates considered in the experiments. Zeta potential and pH measurements were used to monitor the sorption reactions with these ions.

The change in zeta potential of hydrotalcite in distilled water is similarly observed in chloride and nitrate-sorbed hydrotalcite in this study. It indicates that chloride and nitrate ions inspired simply sorption by anion-exchange reaction onto hydrotalcite because that reaction has little influence on zeta potential.

On the other hand, the zeta potential trends for carbonate, sulfate, phosphate and silicate-sorbed hydrotalcite are in contrast. These exhibited lower zeta potential values which would suggest that the point of zero charge (PZC) also shifted to lower pH compared to a pHpzc of more than 11 for hydrotalcite in distilled water. These results suggest that the ions considered in this study formed inner-sphere surface complexes on hydrotalcite surface probably via ligand-substitution reaction. Such reactions are expected to change the physico-chemical properties of hydrotalcite (i.e. increased or decreased stability).

Hydrotalcite has two possible sorption sites indicating that sorption mechanism would vary for different anion species.

Keywords: Hydrotalcite; Sorbent; Zeta potential; Complexation reactions

P-51

Weathering resistivity interpreted from the textures of plutonic rocks

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Void structures observed in weathered Inada granite and Kuroishiyama gabbro were examined using quantitative methods such as multifractal analysis, pore size distribution measurement, and effective porosity measurement. And values characterizing the void structures were correlated with uniaxial compressive strengths (UCS) to reveal the weathering resistivity of the plutonic rocks.

Slope of q-Dq-UCS curved surface showing a relationship of generalized dimension spectra and UCSs is steeper in the granite. It means that the UCS of the granite decreases more drastically than the gabbro when their heterogeneities increase similarly.

The granite has granular texture. Continuous and linear void structures occur through weathering, and their fracture density is relatively small. That is why the void structures in the granite largely contribute to the decrease in UCS but influence on the heterogeneity of the void structure is not so strong. On the one hand, the gabbro is characterized by poikilitic texture. Intra-granular fractures in plagioclase are densely distributed and contribute to the increase in the heterogeneity of the void structure. However, the skeleton of amphibole is not so affected by weathering and thus the strength of the gabbro is maintained.

The results show that the UCS of the granite decreases more easily by weathering than the gabbro when the two plutonic rocks are compared based on their void structures. This indicates that the gabbro has higher weathering resistivity than the granite even though the granite is composed of minerals which have relatively high weathering resistivity such as quartz, and it is attributed to their microscopic void structures.

Keywords: weathering, void structure, multifractal analysis, plutonic rock

P-52

Chloride ion diffusion coefficient of stressed fiber reinforced concrete under loading conditions

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To examine the chloride penetration into concrete is one of the most important to assess the durability of concrete structures. The concrete structures are always subjected to various loads, prestressing as well as traffic, earthquake and so on. Many cracks exist in the stressed concrete, and it is considered that these cracks accelerate the deterioration caused by chloride ion or other substance penetration. However, only few attempts have been made so far for the chloride penetration into concrete under loading condition. Therefore, it is needed for the durability of concrete structures to examine the effect of loading for the chloride penetration into concrete.

In addition, admixing short fibers into concrete can improve the properties of concrete. As a result of admixing fibers, the concrete can alter development of crack that was caused by loading or environmental effects. Therefore, it is considered that the chloride penetration into concrete can be reduced due to the mix of short fibers into concrete.

In this study, the chloride penetration into short fiber reinforced concrete under several loading condition was examined. From the results, it was found that the chloride diffusion coefficient (Dnssm) reduced at low stress level under static compressive loading condition, and the Dnssm at around 50% stress level changed to increase, and then the Dnssm increased with the increase of static compressive loading level after that. On the other hand, the change of Dnssm under tensile loading was differed from that under compressive loading level. The Dnssm subjected to tensile stress showed the increase with the increase of tensile stress level after subjected to low tensile stress.

The change of Dnssm for short fiber reinforced concrete showed almost same behavior under both loading conditions, however, the change ratio of Dnssm with the change of stress level differed from that of non- fiber concrete. And it was found that mixing short fibers into concrete could lead to the improvement of chloride penetration resistance under loading conditions.

From these findings, it was confirmed that loading affects the chloride penetration into concrete. And it was suggested that mixing short fibers into concrete could improve the durability of concrete structures due to the increase in resistance of chloride penetration.

Keywords: Short Fiber Reinforced Concrete, Chloride Ion, Diffusion Coefficient, under Loading

P-53

THE CONTRIBUTION OF RPOS TO FORMATION OF ESCHERICHIA COLI BIOFILMS

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It is now apparent that microorganisms undergo significant changes during the transition from planktonic to biofilm growth that possess enhanced resistance to various stresses such as chlorine treatments and antimicrobial agents. It has been suggested that the creation of starved, stationary phase zones in biofilms seems to be a significant factor for biofilm formation. In this study, the role of rpoS gene in Escherichia coli biofilms was investigated which is known to be expressed during entry into stationary phase and stress conditions. To assess the importance of rpoS gene for biofilm formation, we used E. coli MG1655 rpoS mutant strain to perform flow chamber experiment. We found that the rpoS mutant can only form thin biofilms. To further assess the role of the rpoS gene in E. coli, we performed DNA microarray analysis, and it revealed that gene expression pattern of rpoS mutant was different from that of wild type strain. In stationary phase, 193 genes were significantly down-regulated in rpoS mutant, which included genes induced in starvation conditions, genes encoding heat shock proteins, genes induced at high temperature, and osmotically inducible genes. These results suggest that the rpoS mutant is less capable of response and adaptation to stresses than the wild type strain in stationary phase, which might be the reason for the formation of only thin biofilms. In addition, they also suggest that the rpoS mutant shows too much motility even in the stationary phase. It could explain the presence of the actively moving and rotating cells in the early stages of biofilm formation, which might be the reason for E. coli rpoS mutant to be incapable of establishing mature biofilms. Based on these results, we concluded that rpoS gene which is induced in the stationary phase and stress conditions is important for formation of mature biofilms.

Keywords: biofilms, gene expression, rpoS, Escherichia coli, stress response

P-54

Evaluation of char derived from solid waste for fuel recovery and final disposal in landfill

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Carbonization is a kind of thermal treatment process to produce carbonaceous materials, so-called char, under inert atmosphere. In this work, chars derived from various municipal and industrial solid wastes were evaluated from the standpoint of fuel recovery and thermal pretreatment before landfilling.

The quality of char as a fuel definitely depends on the composition of input wastes. The higher the ratio of woody biomass in raw wastes, the better the quality of the char produced. The estimation equation of char heating value by using its weight fraction of fixed carbon (FC) and volatile matter (VM) was derived; estimated heating values showed a good correlation with measured ones (R2=0.957). Regarding quality improvement of char, the pulverization and sieving method effective in separation of incombustibles rather than ash. From the application of coal cleaning or separation techniques (ex: sink-floatation, froath floatation, and oil agglomeration in liquid) for ash removal from char, char particles existed as compounds of combustibles and ash. Moreover, char particles have a tendency to coagulate in water. These characteristics indicate that wet separation using an aqueous solution likely reduces efficiency due to particle coagulation. Further ash separation should be studied for improving char quality. On the other hand, most char met a 0.5 wt% chlorine criterion allowing it to be utilized as shaft blast furnace fuel after water washing.

Carbonization has an excellent effect on reduction of organic matter disposed in landfills. Releasing of heavy metals such as chrome, cadmium, and lead decreased remarkably by carbonization regardless of the type of raw waste at JLT-13 leaching test. However, it was found that metal leaching from carbonization residue could be changed somewhat by landfill environment such as aerobic or anaerobic condition through column tests.

From these results, carbonization might be considered as a feasible option for pre-treatment before landfills, as well as for fuel recovery.

Keywords: Carbonization, char, quality improvement, pre-treatment for landfilling

P-55

Advanced Application of Jig Separator for Plastic Material Recycling

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Development of mechanical separation of different plastics is essential in planning and constructing a recycling plant that processes scrapped electric appliances or automobiles. The authors have improved TACUB jig as a plastic separator. Jig separation for plastics of smaller sizes (0.5-3 mm) but similar specific gravities was performed using polyvinyl chloride (PVC), polyethylene (PE), acrylonitrile butadiene styrene (ABS), and acrylicplastics from scrapped plastic rods and electric wires. At the minimum difference in the specific gravities of 0.03, a higher grade product over 99% was still obtained. The pulsation of frequency and amplitude for smaller size plastics is lesser than that for coarser plastics. Based on the results, jig separator was applied to the following process.

For the plastics from scrapped copy machines containing polystyrene (PS),ABS, and polyethylene terephthalate (PET), high grade (>99%) of each plastic was recovered in the two cells of the jig, where PET is recovered from the first cell as bottom product, and ABS and PS from the second cell as bottom and upper layer products, respectively. Their sizes ranged from 3.5-10mmand their specific gravities were 1.03, 1.22 and 1.71 for PS, ABS, and PET respectively. Based on the results a recycling plant for processing scrap office and home appliances had been constructed.

Keywords: Jig, Gravity Concentration, PVC, Waste Plastics, Recycling

P-56

Value material collection by wet process sorting method from various shredder dusts

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----no abstruct

P-57

Sustainable Development

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A flow chart is presented which shows a model of the interdependencies in sustainable development which may be used in education. The model is centered on population. Current projections suggest that population will level out about 10 billion a little before 2100 and that a decline will occur thereafter. In seeking to sustainably support the present population and its anticipated growth many interdependent factors must be considered [1]. These factors are collected into four major components for convenience: water, food, energy and disease. The interdependence of these components occurs through a wide range of factors exemplified by deforestation, climate change, biodiversity, zoonolysis, biotechnology, fertilizer use, fossil fuel use and alternative energy sources. These considerations are presented in a pattern useful for giving an overview of sustainable development to students at universities.

[1] S.F. Lincoln, Challenged Earth: An Overview of Humanity's Stewardship of Earth, Imperial College Press, London, 2006.

P-58

Point and Non-point Source Pollution of Dahuofang Reservoir Catchment Based on a GIS Model and Its Integrated Water Management

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As a strategic and critical surface water resource for the Liao River basin, Dahuofang Reservoir is also an important water resource for Shenyang in Liaoning Province.China. However, in recent years, eutrophication has been reported in its water due to both point and non-point source pollution.
This research was performed to identify the main factors influencing its water quality. In this research, an ArcView hydrology extension script was employed to construct a point and non-point source pollution model based on basic information that has been collected.
The current situation and the future tendency of water pollution in the catchment were identified and suggestions were proposed to enhance the integrated water management which aims to improve the water quality for Dahuofang Reservoir.

P-59

Soil organic carbon, nitrogen and microbial biomass under Larix gmelinii forest in different latitude of Northeast China

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Larix gmelinii forest plays a very important role in both environmental protection and economic development in northern China. We compared soil organic carbon (SOC), nitrogen (N), and microbial biomass in L.gmelinii forest along the latitude in northeast China. Surface SOC, total N and microbial biomass of soil samples collected from L. gmelinii forest along the latitude grads ascending decreased significantly. Surface SOC content decreased from 10.56% to 5.30% along the latitude, and N decreased from 0.88% to 0.29%. In surface soil, the highest microbial biomass carbon (MBC) was 4805.16 mg/kg which located in N44° 22′ , and the lowest MBC was 161.49 mg/kg which located in N53° 33′ . Surface soil microbial biomass nitrogen (MBN) also varied from 1038.54 mg/kg to 99.55 mg/kg with latitude ascent. The ratios of microbial biomass to SOC and N In the southern study sites were significantly higher, when compared to the northern study sites' ones. Differences among sites became less pronounced in subsoil. There were positive and significant correlations between SOC, total N and microbial biomass. The study showed that the tested soil characteristics, both abiotic and biological, significantly liner correlated with the latitude.

Keywords: Larix gmelinii; Latitude; Soil organic carbon and nitrogen; Microbial biomass

P-60

Sustainable production in aquaculture: innovation of closed recirculation aquaculture system and its ripple effects

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The present human industrial activities have great impacts on our environment through emissions of carbon dioxide and other chemical pollutants. Such 'environmentally high-cost' human activities now threaten sustainability of our food production. This general undesirable formula is also applicable to the present fishery production.
In 2003, total fishery production was reported to be 132.2 million tones, of which 41.9 million tones from aquaculture practices and 90.3 million tones from capture. Because of decreasing and/or conservation of fishery resources, aquaculture production has been extremely growing compared to capture, about 67 % growth in volume from 1990 to 2003. However, present aquaculture operations (open water system) have serious environmental impacts, such as water pollution by wasted feeds and feces. Although aquaculture production in the last decade has given it increased importance in the modern food supply, there are growing needs to introduce environmentally low-impact system for sustainable food production.
Recently, closed recirculation aquaculture system is concerned as most desired technology for future aquaculture. There are

a lot of benefit of environmental preservation, cost saving and prevention of fish diseases. Further more, in spite of global climate change or regional weather change, stable production is engaged in this system. However, a lot of issues appear to be resolved to practically introduce this system. For one, closed recirculation system are much more expensive to construct, install, and maintain than the open water system.
In this study, the issues of introducing closed recirculation system will be raised and discussed from the aspect of fisheries, environmental sociology and international economics.

P-61

Science, participatory research and sustainable land use

William Smith
The University of Auckland

Illustrating on-going research to integrate science into decision-making by farmers on sustainable land use.

P-62

A Study on the Wetland Dynamic and Its Relation with Cropland Reclamation in Sanjiang Plain, China

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Using remote sensing interpretation, we obtained four periods of land use data sets from 1976 to 2005. Based on these data sets, this study analyzed the dynamics of the wetland land cover and the conversion between wetland and other land use types of Sanjiang Plain in the past 30 years with GIS spatial analysis. It shows that the wetland in Sanjiang Plain has been severely damaged; the wetland area decreased by 37.72% from 1976 to 1986, by 15.54% from 1986 to 1995, and by 30.97% from 1995 to 2005, which shows that the situation of wetland loss had much slowed down in1986 to 1995, but in recent years, the reclamation speed still very high. It was showed by conversation matrix that most wetland losing was the result of reclamation, and only small part of lost wetland was converted into grassland and forest. Still, it found that cropland contributed the main part for wetland area increasing for aimless reclaimed cropland was converted into wetland during flood inundation. Both demographic and resource management policies reason were analyzed for the wetland reduction. The result showed that population increasing was the main reason for wetland reduction in the past decades since P.R. of China foundation. Though the speed of wetland loss decreased during the later period, the reclamation of wetland still happened, so the practicable protection measurement of the wetland in Sanjiang Plain should be reinforced further.

Keywords: Wetland, Sanjiang Plain, remote sensing, GIS

P-63

Salinized wasteland monitoring in Daan County, Northeast China, Using GIS and remote sensing

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Western part of Northeast China has suffered substantial land degradation during past decades, due to human impact under climatic variations. We presents an integrated study of expansion process of salinized wasteland in Daan County, a typical salt-affected area in Northeast China, by using Geographical Information System (GIS) and remote sensing. Our study explored that, from 1954 to 2004, the salinized wastland in study area have increased by 135995 ha, and now cover 32.31% of the total area, in the meantime grassland has decreased by 104697 ha and covers only 13.15% of land area. Grasslands, croplands and swamplands were found the three main land use types converted into salinized wasteland. Land use/cover changes show that between 1954 and 2004, 48.6% of grasslands, 42.5% of swamplands, and 14.1% of croplands were transformed to salinized wasteland, respectively. Lastly, the major factors influencing salinized wasteland expansion and land use/cover changes are also explored. In general, climatic factors supplied a potential environment for soil saliniztion. Human-related factors, such as policy, population, overgrazing, and intensified and irrational utilization of land and water resources are the main causes of salinized wasteland expansion.

Key words: Salinized wasteland expansion; Land use change; GIS; Remote sensing; Daan County, Northeast China

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International trade of Recyclable Resources in Thailand

So Sasaki
Japan Society for the Promotion of Science

Recently, in Asian Regions there has been active trade of Recyclable Resources. Several Studies have been made on International trade of Recyclable Resources from Japan to China, but little is known about that other Asian countries. This paper is intended as an investigation into International trade of Recyclable Resources in Thailand and the efforts of the Thai government. As a result, it has been understood as follow. First, Thailand was received the influence of the demand for Recyclable Resources in China. Second, there are some second-hand goods import limitations in Thailand. However, third, Thai government is doing flexible correspondence to International trade of Recyclable Resources under certain conditions. To put it briefly the concept of International trade of Recyclable Resources in the future, Thailand shows some suggestive cases.

P-65

Today's Development of a sustainable agro system in dry areas of Mongolia

Eldevochir Sukhee
Khash Tsagaan Arslan Co., Ltd.

How to use this restored pasture that was completely barren 5 years ago will be one of the problems to be solved.

P-66

Biotechnology Innovations and Patent Protection

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Is patenting biotechnology desirable to encourage biotechnology innovations in the light of economic perspective? To answer to this question, it is necessary to consider both the characteristics of biotechnology innovations and the impact of patenting biotechnology (e.g. DNA, gene fragments, etc) to the biotechnology industry as well as the international relationship between developed and developing countries.

P-67

Temporal Variability of the Volume Transport through the Korea Strait and the Tsugaru Strait and the Tsugaru Strait

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The volume transports (VT) through the Korea Strait and Tsugaru Strait are estimated from linear regressions between transport data and the sea level difference (SLD) across the straits. As the sea level data along the Korean and Japanese coasts have been measured for several decades, the VTs can be estimated for a long period during which the sea level data are available. For the Korea Strait the SLD was calculated between Pusan and Moji. The transport data by the submarine cable was used to get the conversion equation from the SLD to the VT (Lyu and Kim, 2003). The atmospheric pressure effect and the baroclinic part of SLD were removed before computing the conversion equation. For the Tsugaru Strait Tappi and Yoshioka were selected to calculate the SLD. The conversion equation for the Tsugaru Strait was obtained by using the transport data from the vessel mounted ADCP (Ito et al., 2003). The mean value of the VT from 1984 through 2004 is 2.5 Sv for the Korea Strait and 1.5 Sv for the Tsugaru Strait is 1.5 Sv. It is found that variance of the VT through the

Korea Strait during this period is partitioned 33 %, 23 % and 44 % for seasonal, interannual and intraseasonal time scales respectively. Partition for the Tsugaru Strait is 59 %, 16 % and 25 % for the same temporal scales. Forcing for these temporal variation is under investigation by examining statistical relations between transports and various atmospheric and oceanic parameters.

P-68

Argo for long-term ocean variability and climate research

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Argo is a global array of 3,000 free-drifting profiling floats that measures the temperature and salinity of the upper 2000 m of the ocean. This allows, for the first time, continuous monitoring of the temperature, salinity, and velocity of the upper ocean, with all data being relayed and made publicly available within hours after collection.
We are increasingly concerned about global change and its regional impacts. Sea level is rising at an accelerating rate of 3 mm/year, Arctic sea ice cover is shrinking and high latitude areas are warming rapidly. Extreme weather events cause loss of life and enormous burdens on the insurance industry. Globally, 8 of the 10 warmest years since 1860, when instrumental records began, were in the past decade. These effects are caused by a mixture of long-term climate change and natural variability. Their impacts are in some cases beneficial (lengthened growing seasons, opening of Arctic shipping routes) and in others adverse (increased coastal flooding, severe droughts, more extreme and frequent heat waves and weather events such as severe tropical cyclones).
Understanding (and eventually predicting) changes in both the atmosphere and ocean are needed to guide international actions, to optimize governments' policies and to shape industrial strategies. To make those predictions we need improved models of climate and of the entire earth system (including socio-economic factors). Lack of sustained observations of the atmosphere, oceans and land have hindered the development and validation of climate models. An example comes from a recent analysis which concluded that the currents transporting heat northwards in the Atlantic and influencing western European climate had weakened by 30% in the past decade. This result had to be based on just five research measurements spread over 40 years. Was this change part of a trend that might lead to a major change in the Atlantic circulation, or due to natural variability that will reverse in the future, or is it an artifact of the limited observations? In 1999, to combat this lack of data, an innovative step was taken by scientists to greatly improve the collection of observations inside the ocean through increased sampling of old and new quantities and increased coverage in terms of time and area. (from www.argo.ucsd.edu)

P-69

Issues and opportunities in sustainable management of water through the community based organizations in South Asian Countries - A case study in Sri Lanka -

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In developing countries there are lots of problems in managing the water supply schemes. The Community based organization (CBO) has came into consideration as a solution for problems. But there are enough experiences for identifying issues and opportunities that can be used as a lesion to have sustainable water management schemes in the region. This study was based on the evaluation on the CBO's.

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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	*Registration at Hokkaido University Conference Hall*
	Welcome Party at Hokkaido University Centennial Hall

Day One: Monday, August 7

Plenary Sessions: Comprehensive View of Sustainable Development

at Hokkaido University Conference Hall - Auditorium A

8:00am -	*Registration*

Opening

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

Keynote Speech

9:00am - 9:45am	*Prospects of the 21st Century with Respect to Sustainability* **Itaru Yasui**, United Nations University, Japan ···P7-20
9:45am - 10:00am	*Break*

Session 1. Sustainability of the Earth System

Chairperson: **Motoyoshi Ikeda**, Faculty of Environmental Earth Science, Hokkaido University ···P38

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

Session 2. Sustainable Society with Recycling System

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

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

Session 3. Emerging Infections and Global Environment

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

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

Session 4. Sustainability Governance on Food and Bioresource

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

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

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

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

8:30am - 9:00am	*Opening Remarks* **Yoshihito Osada**, Hokkaido University **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 Universtiy
9:20am - 9:40am	*Genetic Approach to Management and Sustainable Use of Marine Bio-Resources* **Syuichi 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 Unviersity
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 Hightly 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 Nil 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 Trypanosomiases* **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
9:40am - 10:30pm	*Performance of Pre-denitrification Submerged Membrane Bioreactor (MBR) under Various Solid Retention Times* 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
10:30am - 11:20am	*An Approach towards a Better Understanding of Fouling Phenomena in MBR* 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
11:20am - 12:10pm	*Membrane Biofouling in the MBR Treating Domestic Wastewater: Identification of Key Players in Membrane Biofouling* 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
1:30pm - 2:20pm	*Nanomaterials and Membranes for Water and Wastewater Treatment* 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
2:20pm - 3:10pm	*Mechanism Involved in the Evolution of Irreversible Fouling in Microfiltration (MF) and Ultrafiltraion (UF) Membranes Used for Water Treatment* 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	*Break*
3:30pm -	*Track for Drinking Water II* Moderator: **Yoshimasa Watanabe**, Graduate School of Engineering, Hokkaido University
3:30pm - 4:20pm	*Recovery of Spent Filter Backwash Water Using Coagulation-Assisted Membrane Filtration* Speaker: **Chihpin Huang**, Institute of Environmental Engineering, National Chiao Tung University, Taiwan *Discussion for "Recovery of Spent Backwash Water Using Coagulation-Assisted Membrane Filtration"* Discusser: **So-Ryong Chae**, Graduate School of Engineering, Hokkaido University
4:20pm - 5:10pm	*Low Pressure Membrane Filtration for Drinking Water Production in Germany : State of the Art and Future Developments* Speaker: **Stefan Panglisch**, Department of Water Technology, IWW Water Center, Germany *Comment on "Low Pressure Membrane Filtration for Drinking Water Production in Germany State of the Art and Future Developments"* Discusser: **Chung-Hak Lee**, School of Chemical and Biological Engineering, Seoul National University, Korea
5:10pm - 5:30pm	*Closing*
6:00pm -	*Party*

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 -	*Registration*

Opening

1:30pm -	*Opening* **Toshihiko Matsuto**, Graduate School of Engineering, Hokkaido University

Session

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

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

9:30am - 11:30am	*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
	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	*An Evaluation of Water Allocation Mechanisms: A Korean Case* **Dong-Geun Han**, School of Economics and Finance, Yeungnam University, Korea …P158-160
3:00pm - 3:20pm	*Challenges and Strategies for the Planning and Design of Sustainable Landscapes* **Jack Ahern**, Department of Landscape Architecture and Regional Planning, University of Massachusetts, Amherst, U.S.A. …P161-164
3:20pm - 3:40pm	*Creating Effective International Regimes: New Approach of Political Science* **Toru Miyamoto**, Graduate School of Public Policy, Hokkaido University …P165-167
3:40pm - 3:45pm	*Summary of This Session*
3:45pm - 4:00pm	*Break*

Session 4. Summary of the Symposium

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

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

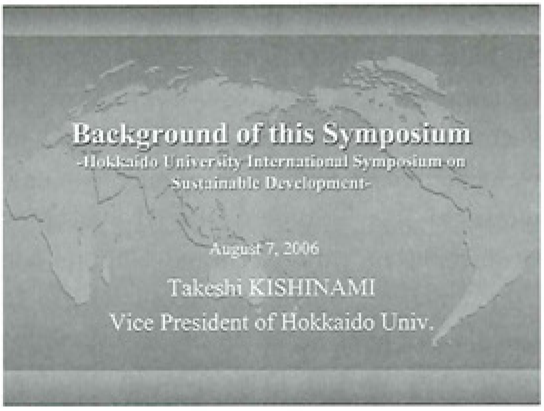
Hokkaido University Initiative for Sustainable Development, established in November 2005, has declared its objectives as follows:

- 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 infections 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.

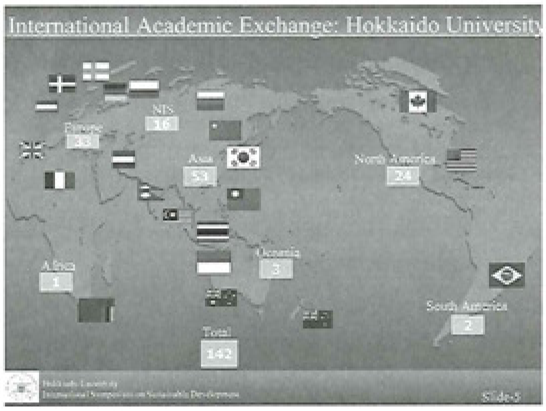

Background of this Symposium
-Hokkaido University International Symposium on Sustainable Development-
August 7, 2006
Takeshi KISHINAMI
Vice President of Hokkaido Univ.


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 Kyusyu Imperial University
1931 Osaka Imperial University
1939 Nagoya Imperial University
1947-2004 Hokkaido University
October, 2001 The 125th Anniversary of the University
April, 2004- National University Corporation Hokkaido University
Slide-1


Basic Philosophies of Hokkaido University
Frontier Spirit
Global Perspective
All-Round Education
Practical Learning
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
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
Slide-4


International Academic Exchange: Hokkaido University
NIS
16
Asia
53
North America
24
Africa
1
Oceania
3
South America
2
Total
142
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, Marin science, Agriculture and Zoonosis in H.U.
3. Strengthening International Collaborative Research between Foreign Universities and Hokkaido University
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 Infections Diseases
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

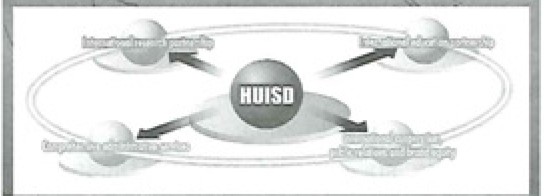
Challenges of this Symposium

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

Hokkaido University
International Symposium on Sustainable Development
Slide-9

Benefits through the Symposium

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



Hokkaido University
International Symposium on Sustainable Development
Slide-10

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 counties, 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 Luxemburg 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.

—Porf. 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.

—Quesioner 2—

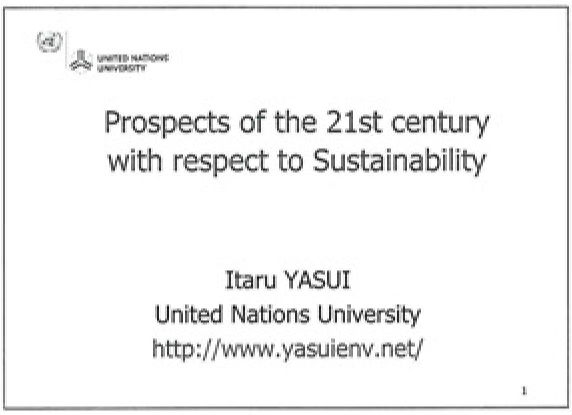
Thank you very much for this presentation. I think that if we have to reach these goals and the prospects of the 21st century, our advantage is that the people will not live 100 years to see whether our strategies functioned, or not. Do you think we need many more strategies or efforts? There is disorder 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.

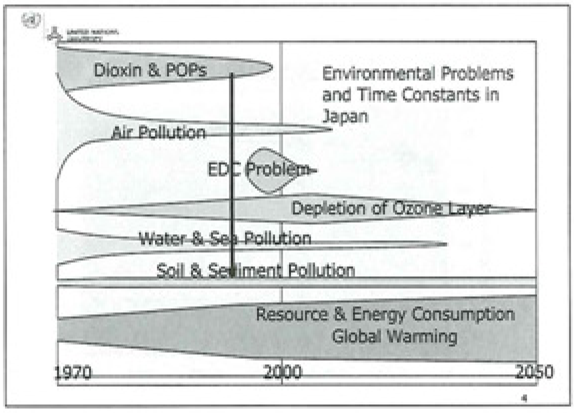
—Prof. Itaru Yasui—

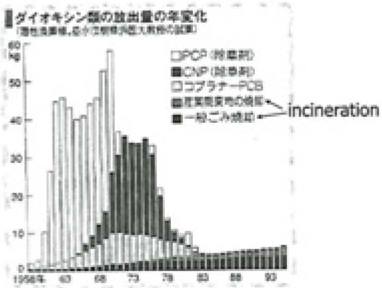
Thank you very much. I think it's an important point, and I have almost the same feeling as you. The solution is very difficult. I would say, as a person in the UN organisation, that the advanced countries should increase ODA. We have some pledges since 1970, and we repeated them several times. The last 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.







Emission of Dioxin and Related Chemicals to Environment

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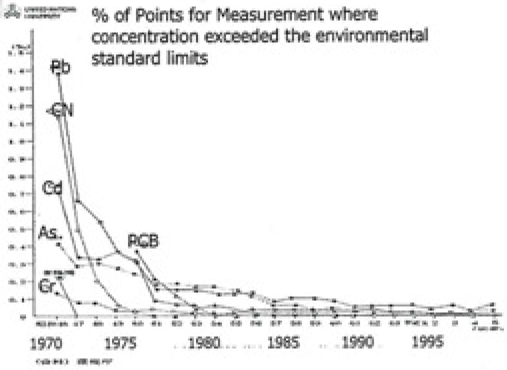


6

What is Sustainable Development?

7

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:

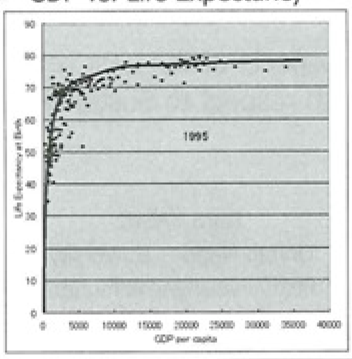
8

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

GDP vs. Life Expectancy



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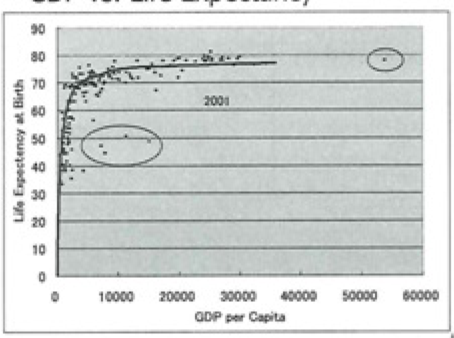
GDP vs. Life Expectancy



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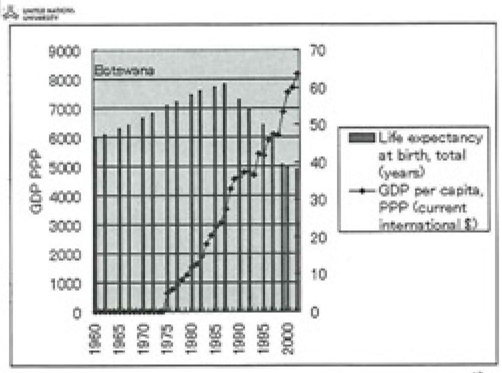

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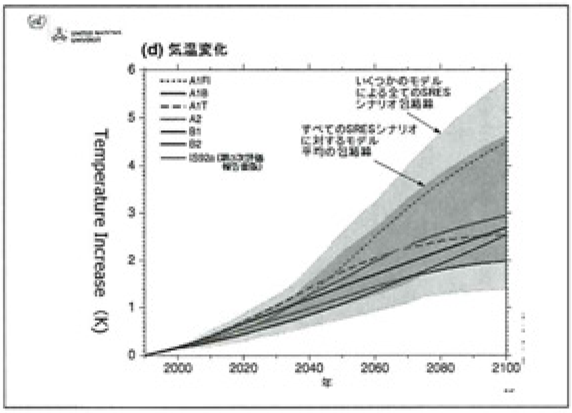
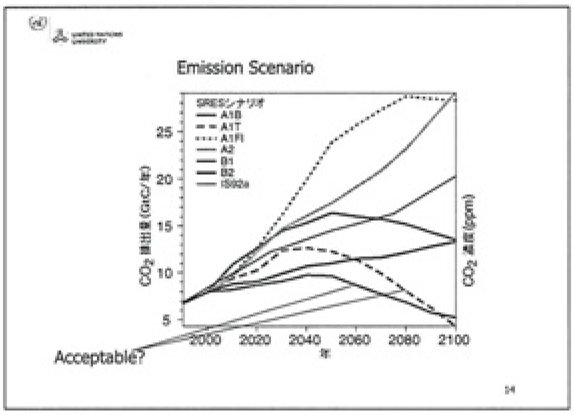
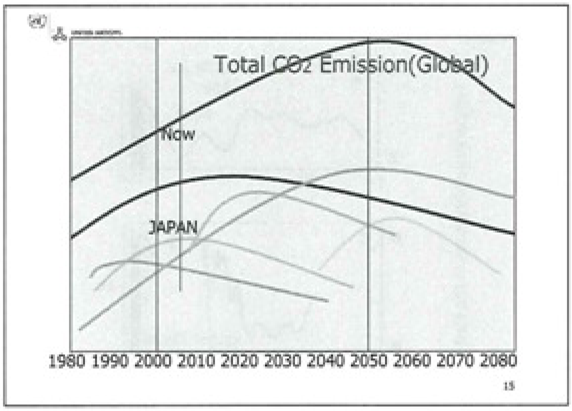
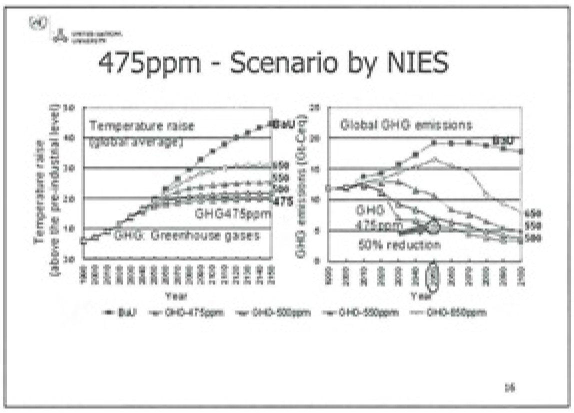
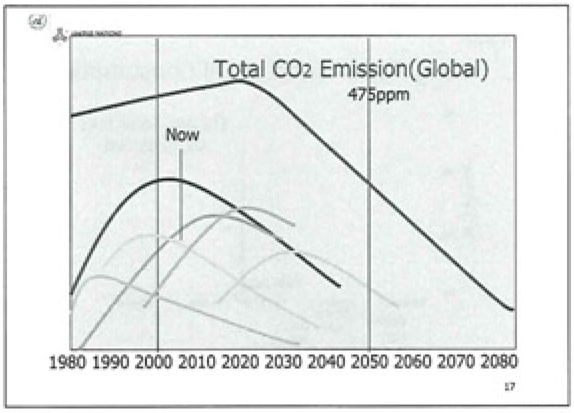
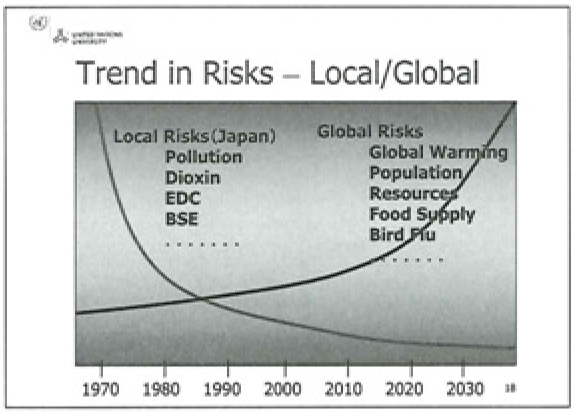






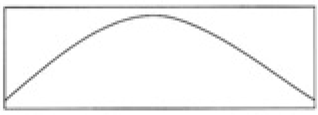






Environmental Transition

- Understand the Trend of Environmental Issues by using Several Curves!



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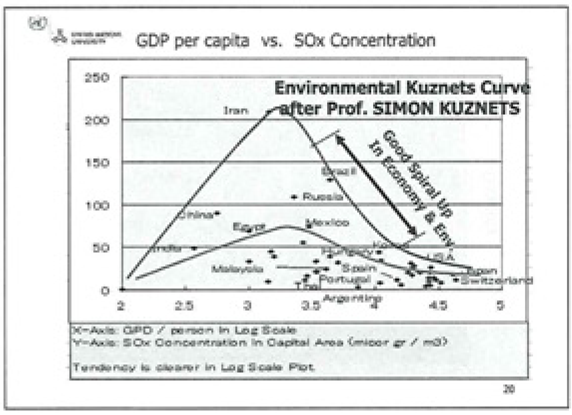
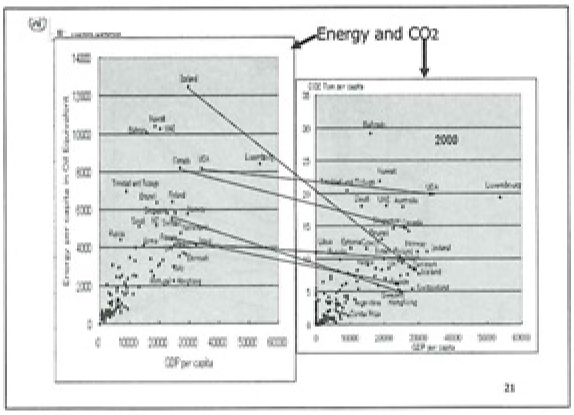
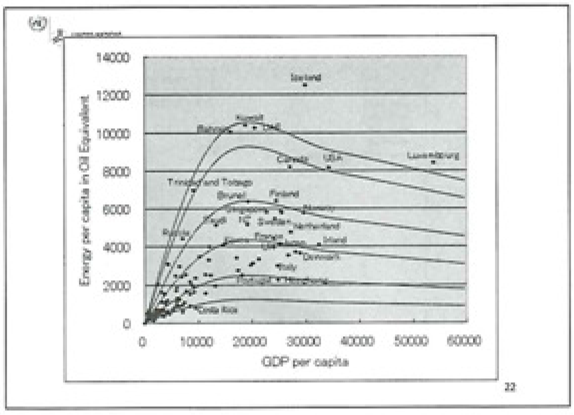
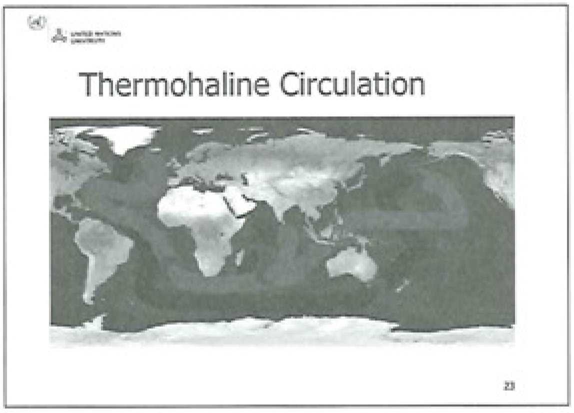
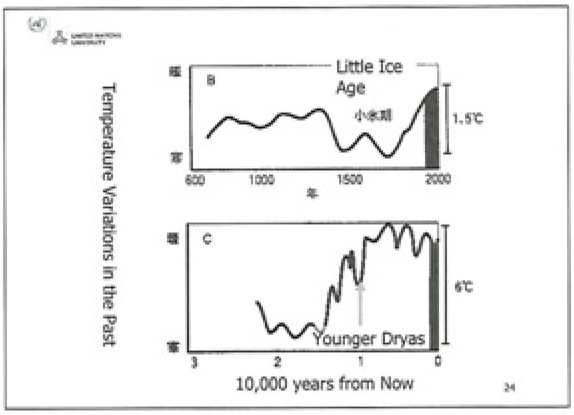
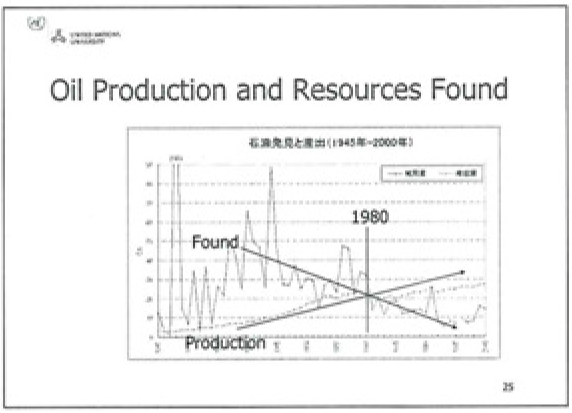


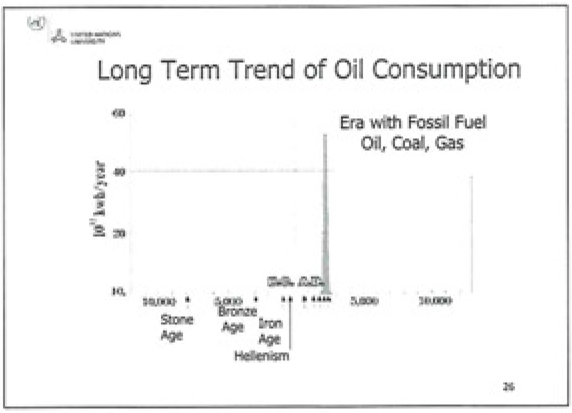

Energy and CO2
2000
GDP per capita
21

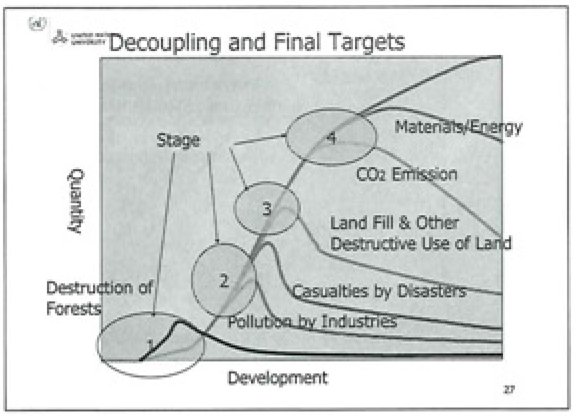

Energy per capita in Oil Equivalent
GDP per capita
22

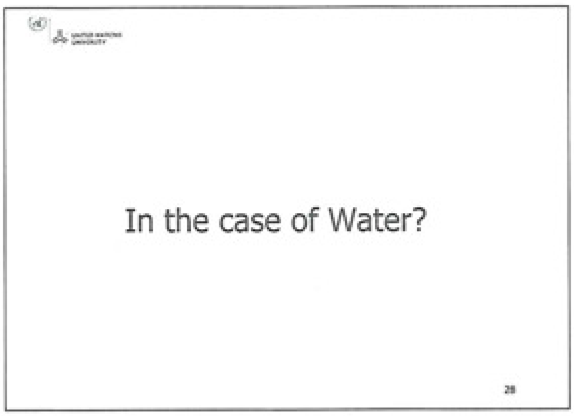

Thermohaline Circulation
23


Temperature Variations in the Past
Little Ice Age
小氷期
1.5℃
6℃
Younger Dryas
10,000 years from Now
24


Oil Production and Resources Found
1980
Found
Production
25


Long Term Trend of Oil Consumption
Era with Fossil Fuel
Oil, Coal, Gas
Stone Age
Bronze Age
Iron Age
Hellenism
26


Decoupling and Final Targets
Stage
Quantity
Materials/Energy
CO2 Emission
Land Fill & Other Destructive Use of Land
Casualties by Disasters
Pollution by Industries
Destruction of Forests
Development
27


In the case of Water?
28

Daily Risk and Loss of Life Expectancies

	World	Japan*	North Am	EU
Underweight	20.73	0.01	0.01	0.00
Iron deficiency	4.22	0.05	0.18	0.09
Vitamin A deficiency	4.25	0.00	0.00	0.00
Zinc deficiency	4.35	0.00	0.00	0.00
Blood pressure	9.07	5.94	7.03	8.86
Cholesterol	5.71	3.01	6.44	6.97
Overweight	3.78	1.92	6.58	5.71
Low fruit and vegetable intake	3.83	1.87	3.65	2.53
Physical inactivity	2.59	1.78	3.03	2.95
Unsafe sex	12.57	0.23	0.88	0.46
Lack of contraception	0.69	0.00	0.00	0.00
Tobacco	7.45	6.15	13.81	11.43
Alcohol	5.34	1.61	2.80	3.01
Illicit drugs	0.79	0.49	1.27	0.97
Unsafe water, sanitation and hygiene	8.04	0.03	0.02	0.02
Urban air pollution	1.05	0.54	0.48	0.28
Indoor smoke from solid fuels	5.74	0.00	0.01	0.00
Lead exposure	0.46	0.05	0.12	0.13
Climate change	0.81	0.00	0.01	0.00
Risk factors for injury	1.16	0.23	0.20	0.23
Carcinogens	0.22	0.23	0.28	0.35
Airborne particulates	0.24	0.06	0.21	0.17
Ergonomic stressors	0.00	0.00	0.00	0.00
Noise	0.00	0.00	0.00	0.00
Unsafe health care injections	1.50	0.00	0.00	0.00
Childhood sexual abuse	0.28	0.16	0.12	0.07

29

Water Use in Japan

- Daily Life: 130m³／Year・person
- Industrial Use: 110m³／Y・person
- Agricultural Use: 460m³／Y・person
- All Three Categories -- Decreasing
- Virtual Water : 600m³／Y・person =Indirect Import of Water
- Four Factors =Beef, Maize, Soy, Wheat
- In total, Japan use More Water than World Average

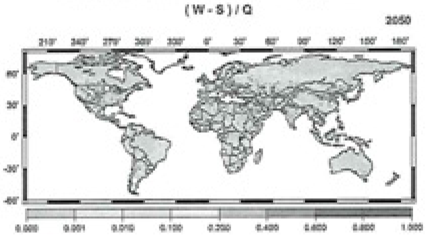
30

Regions with Water Stress

Annual Withdrawal to Availability Ratio

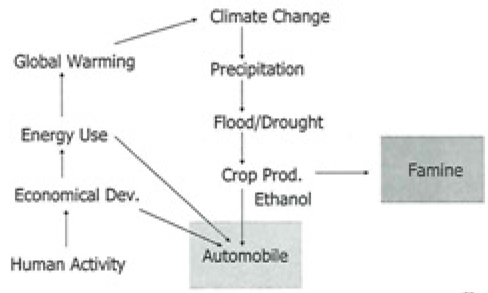
(W-S)/Q

2050



31

Sequences from Human Activities

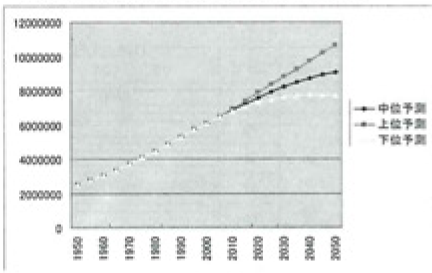


32

Population Issues

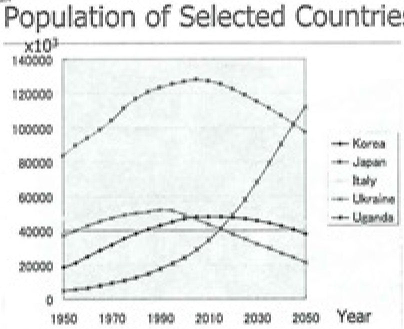
33

UN Population Projection



34

Population of Selected Countries



35

8 Goals in MDG

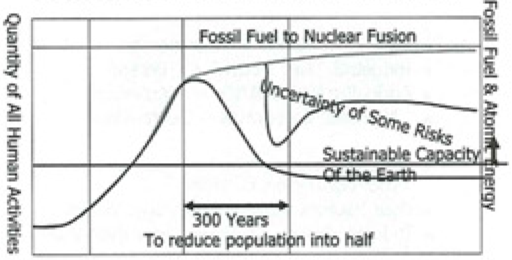
- 1. Eradicate extreme poverty and hunger
- 2. Achieve universal primary education
- 3. Promote gender equality and empower women
- 4. Reduce child mortality

Key Factors to Decrease Population

- 5. Improve maternal health
- 6. Combat HIV/AIDS, malaria and other diseases
- 7. Ensure environmental sustainability
- 8. Develop a global partnership for development

36

Conclusion : Several Scenarios



37

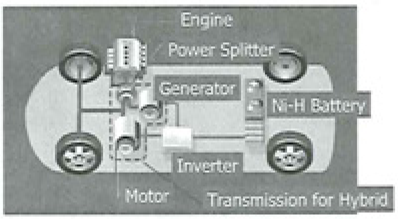
In addition to Population Issue

- 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

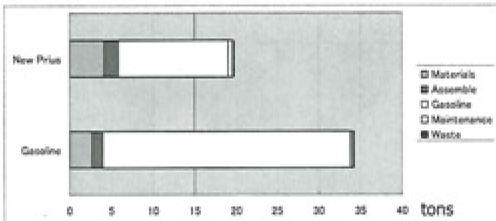
An Example = New Prius

- Hybrid Motor Vehicle by TOYOTA



39

Comparison of CO_2 Emission New Prius and Equivalent



Assumptions: 100,000km Driven in Tokyo
Fuel Consumption: 18km/L for Prius, 8km/L for Others

40

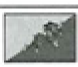
Energy Efficiency of New Prius

	Fuel E	Car E	Overall EE in %
Gasoline	88	16	14%
Prius 1	88	28	25%
Prius 1MC		32	28%
New Prius		37	32%
FCHV Now	58	50	29%
FCHV F	70	60	42%

41

Life in Japan, Life in World

42



Bhutan 13 Family Members

188 US$ 65㎡

Radio 1

(C)Material World / ユニフォトプレス

43

Japan 4 Family Members

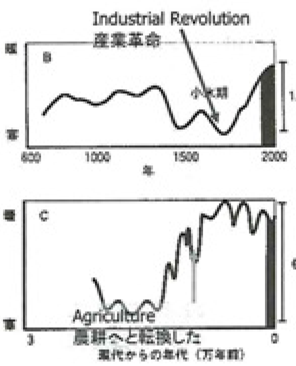
32350 US$ 128㎡

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

44

In medieval Little Ice Age, people started to good use of coal and started "Industrial Revolution".

In Younger Dryas Cooling, people began cultivating some crops.



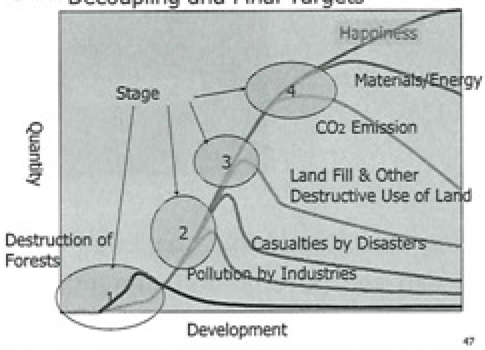
45

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

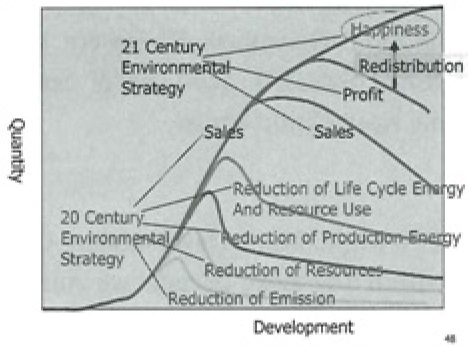
46

Decoupling and Final Targets



47

Economical Activities in 20 & 21 Century



48

Speaker

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

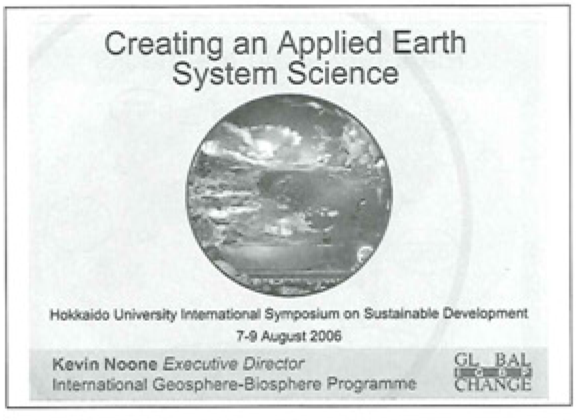
The UN Millennium Development Goals are an inspiring and formidable challenge for society: within the next decade we must aim to eradicate extreme poverty and hunger; achieve universal primary education; promote gender equality and empower women; reduce child mortality; improve maternal health; combat 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.

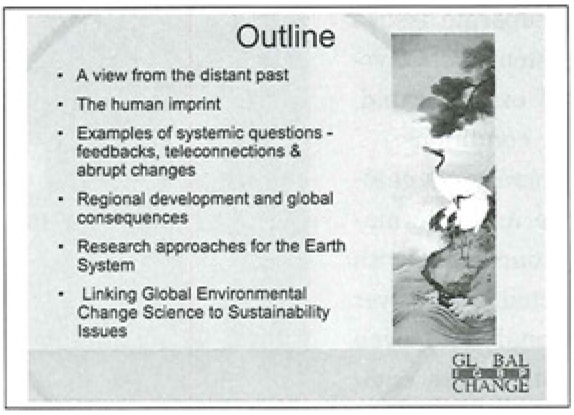
Some have argued that it is not feasible to address all of these issues at once, and that we should simply use a sort of cost-benefit analysis to choose one on which to concentrate. This view may be appealing, but it is fundamentally misguided. It would be a tragedy if, for instance, we were able to 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.

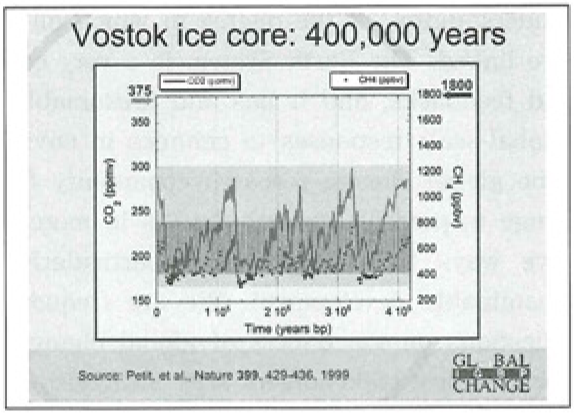
We now know that human activities now match (and often exceed) the natural forces that regulate the Earth System. Recent ice core data show that current levels of carbon dioxide and methane are well outside the range of natural variability over the last 800,000 years. Roughly half of the world's ice-free 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.

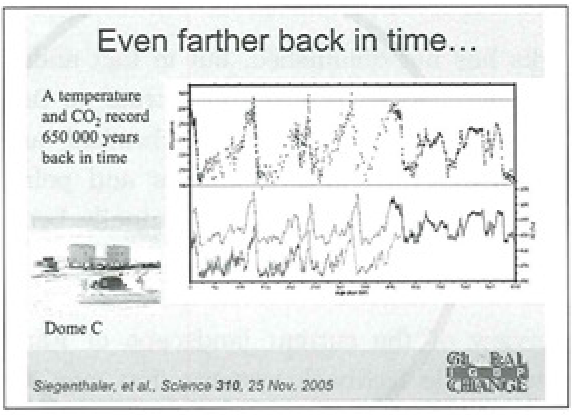
The need to understand how the natural world works has not diminished, but in fact underpins the answers to questions of sustainable development. We still must concentrate on first class science involving the interactions and feedbacks between biological, chemical and physical processes and human systems.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

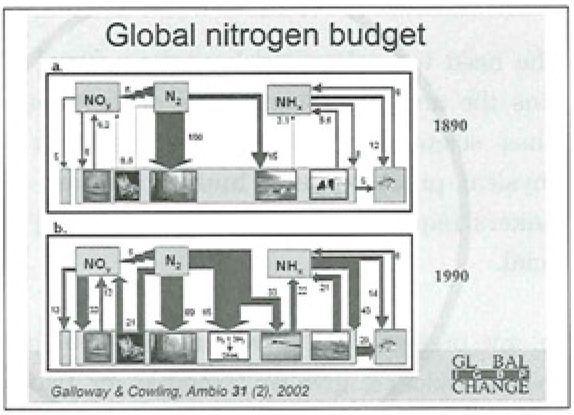
In my presentation, I will attempt to give an overview of the current landscape of Earth *System* Science, give an example (or two) of planetary-scale feedback systems that may impact sustainable development strategies, discuss some the current structural challenges we have in addressing the interdisciplinary 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.

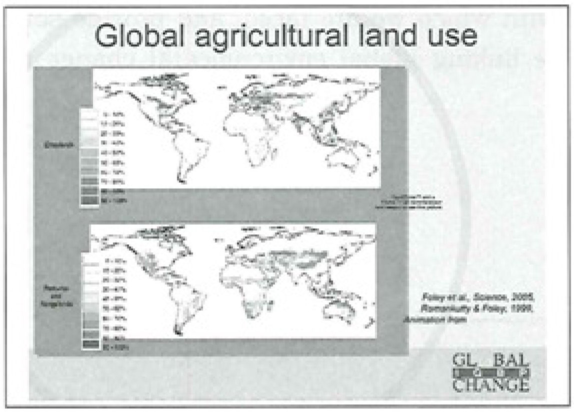



Outline
A view from the distant past
The human imprint
Examples of systemic questions - feedbacks, teleconnections & abrupt changes
Regional development and global consequences
Research approaches for the Earth System
Linking Global Environmental Change Science to Sustainability Issues
GLOBAL CHANGE

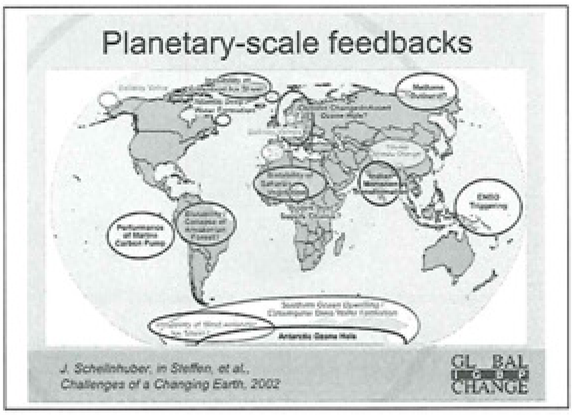

Vostok ice core: 400,000 years
CO2 (ppmv)
CH4 (ppbv)
375
1800
Time (years bp)
Source: Petit, et al., Nature 399, 429-436, 1999
GLOBAL CHANGE

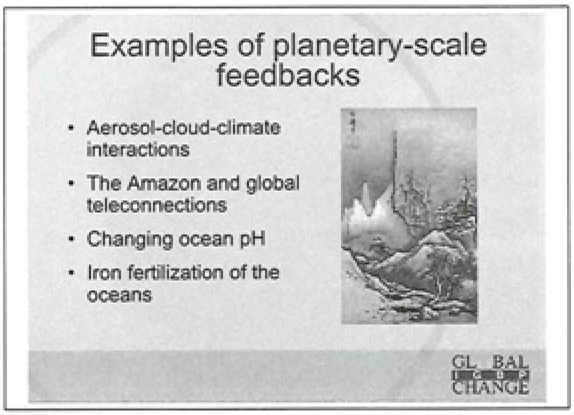

Even farther back in time…
A temperature and CO2 record 650 000 years back in time
Dome C
Siegenthaler, et al., Science 310, 25 Nov. 2005
GLOBAL CHANGE

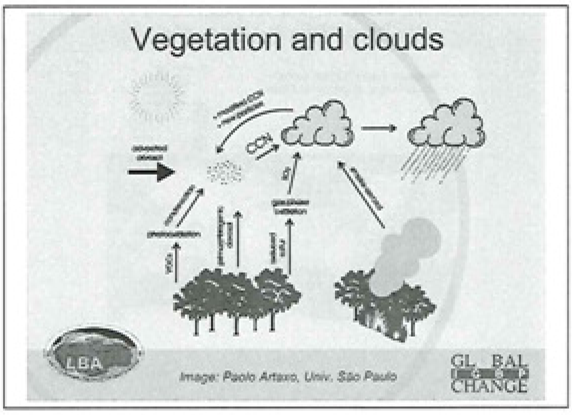

Global nitrogen budget
a.
NOy
N2
NHx
1890
b.
1990
Galloway & Cowling, Ambio 31 (2), 2002
GLOBAL CHANGE

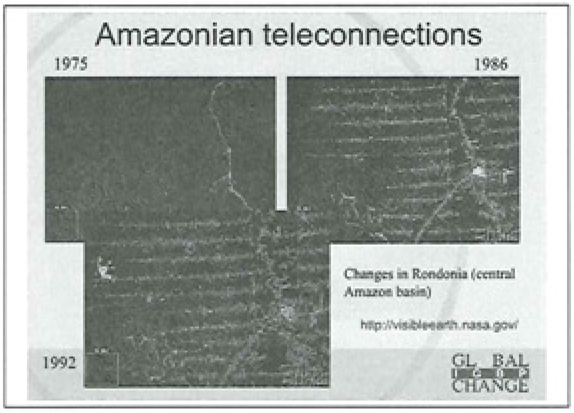

Global agricultural land use
Foley et al., Science, 2005,
Ramankutty & Foley, 1999,
Animation from
GLOBAL CHANGE

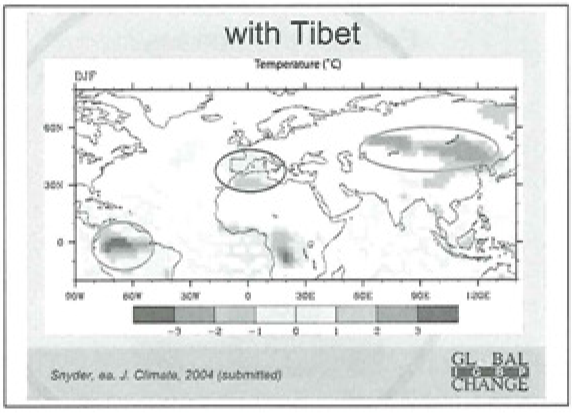

Human influence seen from space
http://visibleearth.nasa.gov/images/1438/earth_lights.jpg
GLOBAL CHANGE

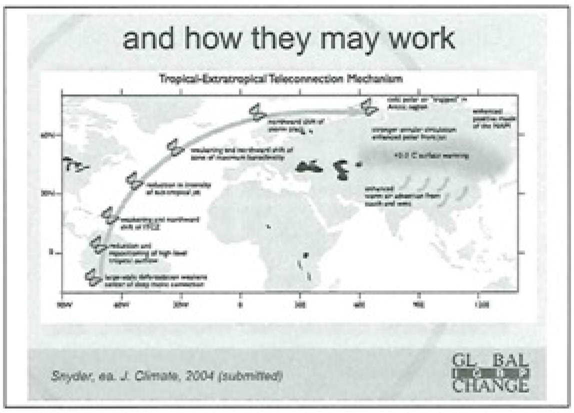

Planetary-scale feedbacks
Methane Outbursts?
ENSO Triggering
Antarctic Ozone Hole
J. Schellnhuber, in Steffen, et al.,
Challenges of a Changing Earth, 2002
GLOBAL CHANGE

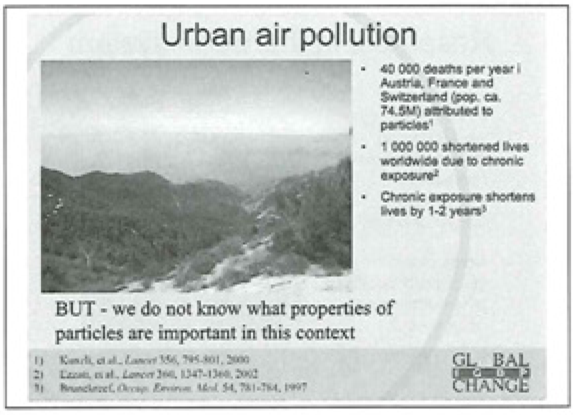

Examples of planetary-scale feedbacks
Aerosol-cloud-climate interactions
The Amazon and global teleconnections
Changing ocean pH
Iron fertilization of the oceans
GLOBAL CHANGE

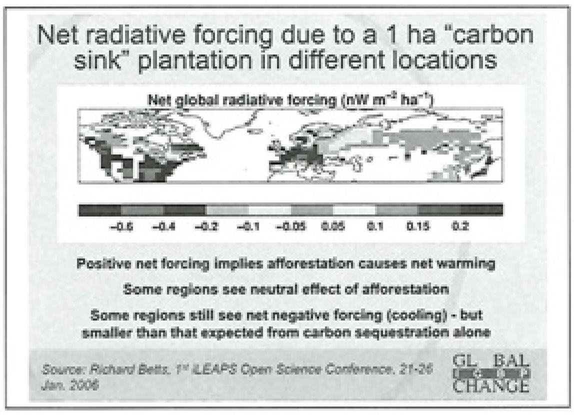

Vegetation and clouds
Image: Paolo Artaxo, Univ. São Paulo
LBA
GLOBAL CHANGE

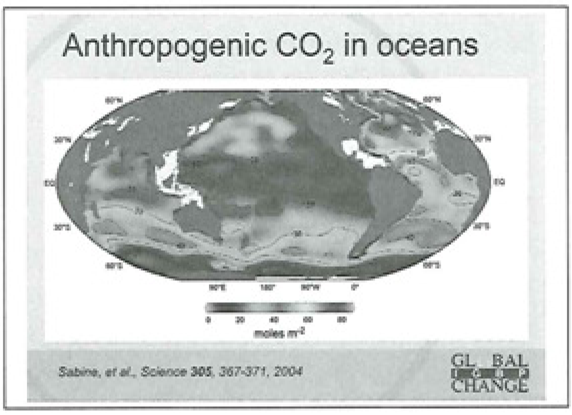

Amazonian teleconnections
1975
1986
1992
Changes in Rondonia (central Amazon basin)
http://visibleearth.nasa.gov/
GLOBAL CHANGE

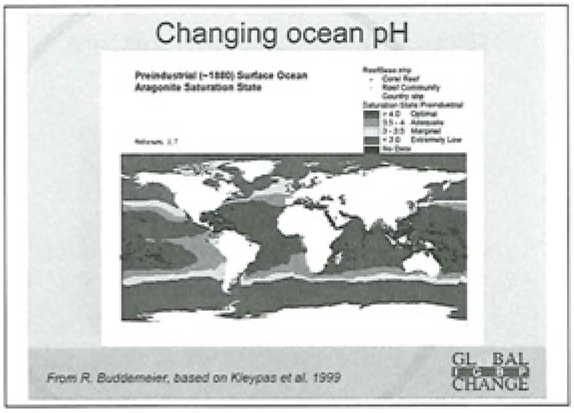

with Tibet
Temperature (°C)
DJF
Snyder, ea. J. Climate, 2004 (submitted)
GLOBAL CHANGE

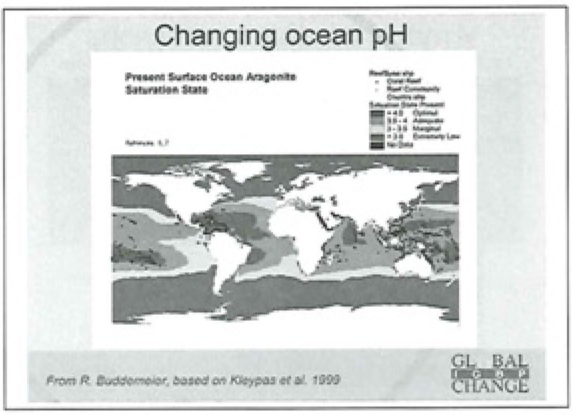

and how they may work
Tropical-Extratropical Teleconnection Mechanism
Snyder, ea. J. Climate, 2004 (submitted)
GLOBAL CHANGE

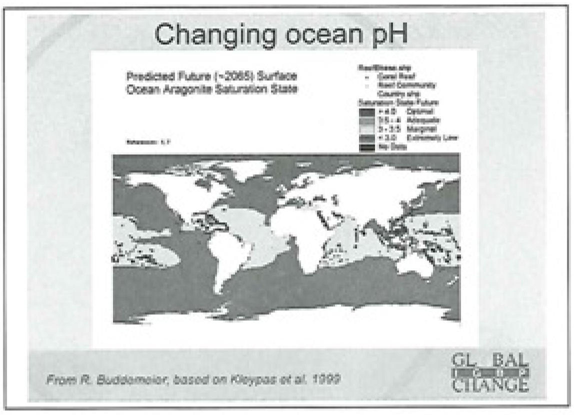

Urban air pollution
40 000 deaths per year i Austria, France and Switzerland (pop. ca. 74,5M) attributed to particles1
1 000 000 shortened lives worldwide due to chronic exposure2
Chronic exposure shortens lives by 1-2 years3
BUT - we do not know what properties of particles are important in this context
1) Kunzli, et al., Lancet 356, 795-801, 2000
GLOBAL CHANGE

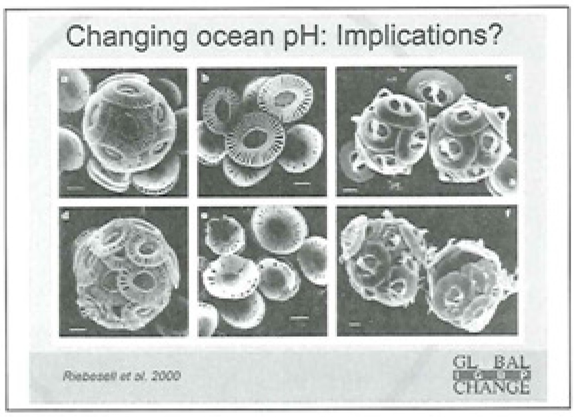

Net radiative forcing due to a 1 ha "carbon sink" plantation in different locations
Net global radiative forcing (nW m-2 ha-1)
-0.6 -0.4 -0.2 -0.1 -0.05 0.05 0.1 0.15 0.2
Positive net forcing implies afforestation causes net warming
Some regions see neutral effect of afforestation
Some regions still see net negative forcing (cooling) - but smaller than that expected from carbon sequestration alone
Source: Richard Betts, 1st iLEAPS Open Science Conference, 21-26 Jan. 2006
GLOBAL CHANGE

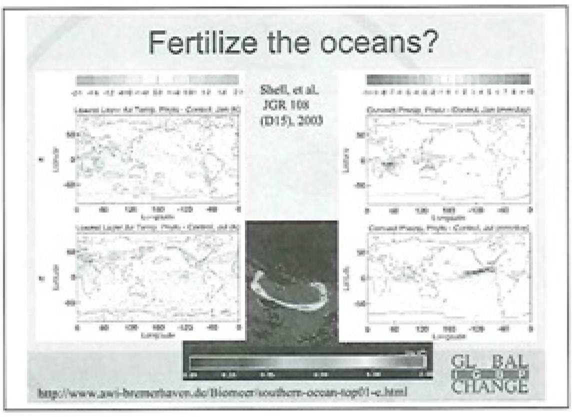

Anthropogenic CO2 in oceans
moles m-2
Sabine, et al., Science 305, 367-371, 2004
GLOBAL CHANGE

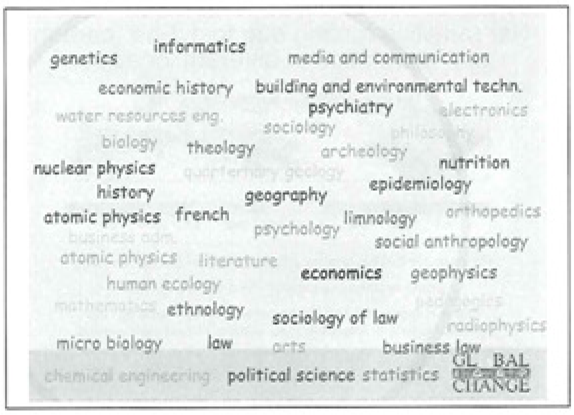

Changing ocean pH
Preindustrial (~1880) Surface Ocean Aragonite Saturation State
From R. Buddemeier, based on Kleypas et al. 1999
GLOBAL CHANGE

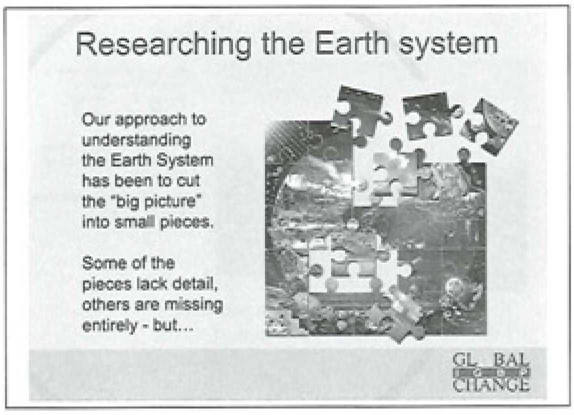

Changing ocean pH
Present Surface Ocean Aragonite Saturation State
From R. Buddemeier, based on Kleypas et al. 1999
GLOBAL CHANGE

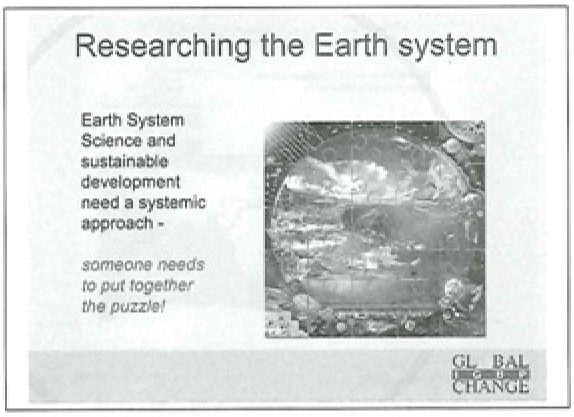

Changing ocean pH
Predicted Future (~2065) Surface Ocean Aragonite Saturation State
From R. Buddemeier, based on Kleypas et al. 1999
GLOBAL CHANGE

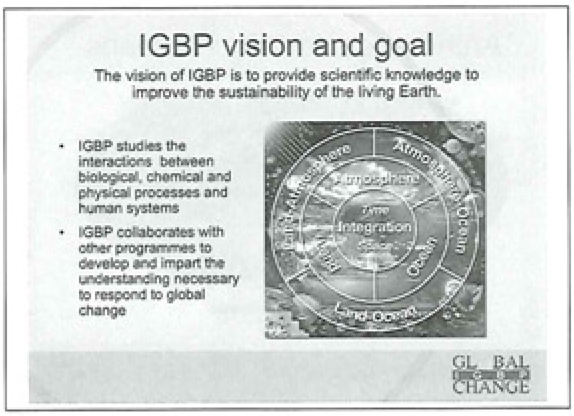

Changing ocean pH: Implications?
Riebesell et al. 2000
GLOBAL CHANGE

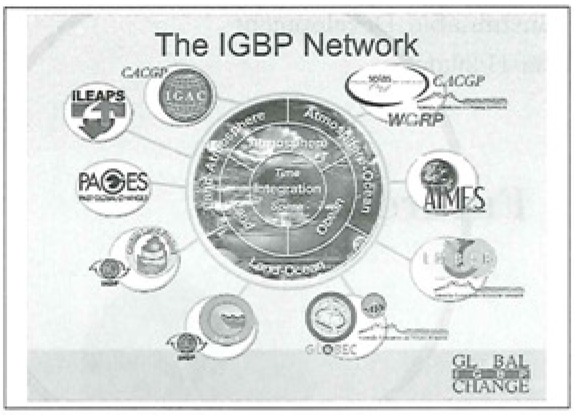

Fertilize the oceans?
Shell, et al. JGR 108 (D15), 2003
GLOBAL CHANGE


genetics
informatics
media and communication
economic history
building and environmental techn.
water resources eng.
psychiatry
electronics
sociology
biology
theology
archeology
philosophy
nuclear physics
quarternary geology
nutrition
history
geography
epidemiology
atomic physics
french
psychology
limnology
orthopedics
business adm.
social anthropology
atomic physics
literature
human ecology
economics
geophysics
mathematics
ethnology
pedagogics
sociology of law
radiophysics
micro biology
law
arts
business law
chemical engineering
political science
statistics
GLOBAL CHANGE

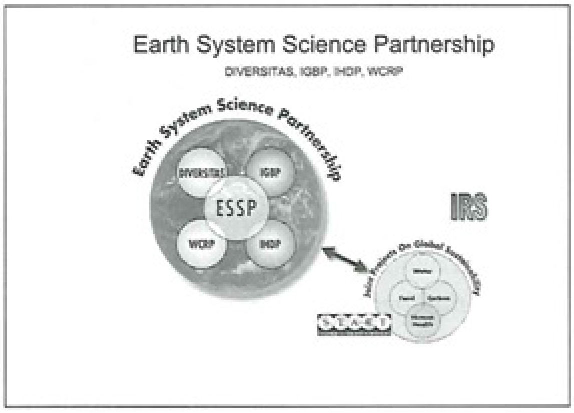

Researching the Earth system
Our approach to understanding the Earth System has been to cut the "big picture" into small pieces.
Some of the pieces lack detail, others are missing entirely - but...
GLOBAL CHANGE

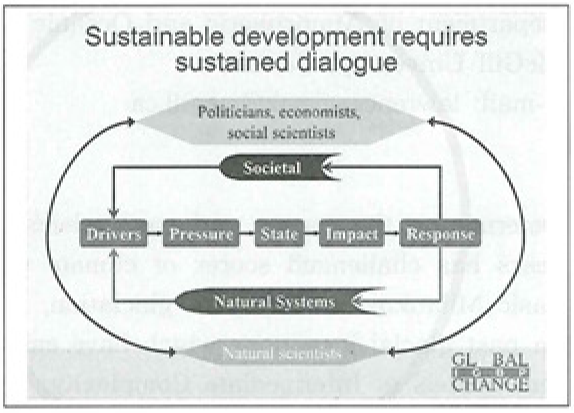

Researching the Earth system
Earth System Science and sustainable development need a systemic approach -
someone needs to put together the puzzle!
GLOBAL CHANGE

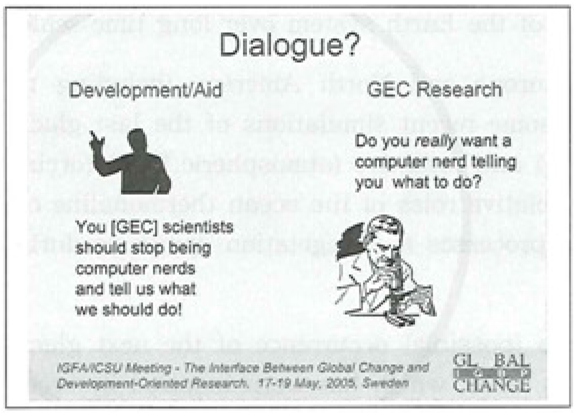

IGBP vision and goal
The vision of IGBP is to provide scientific knowledge to improve the sustainability of the living Earth.
IGBP studies the interactions between biological, chemical and physical processes and human systems
IGBP collaborates with other programmes to develop and impart the understanding necessary to respond to global change
Atmosphere
Integration
Land-Ocean
Ocean
GLOBAL CHANGE

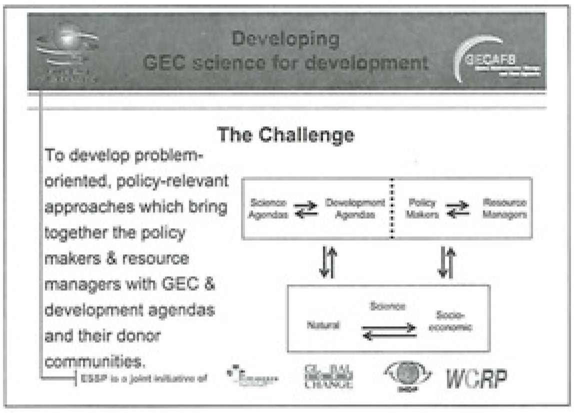

The IGBP Network
CACGP
IGAC
ILEAPS
SOLAS
CACGP
WCRP
PAGES
AIMES
Time
Integration
GLOBEC
GLOBAL CHANGE


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.


Earth System Science Partnership
DIVERSITAS, IGBP, IHDP, WCRP
Earth System Science Partnership
DIVERSITAS
IGBP
ESSP
WCRP
IHDP
IRS
START


Sustainable development requires sustained dialogue
Politicians, economists, social scientists
Societal
Drivers
Pressure
State
Impact
Response
Natural Systems
Natural scientists
GLOBAL CHANGE


Dialogue?
Development/Aid
GEC Research
Do you really want a computer nerd telling you what to do?
You [GEC] scientists should stop being computer nerds and tell us what we should do!
IGFA/ICSU Meeting - The Interface Between Global Change and Development-Oriented Research, 17-19 May, 2005, Sweden
GLOBAL CHANGE


Developing
GEC science for development
GECAFS
The Challenge
To develop problem-oriented, policy-relevant approaches which bring together the policy makers & resource managers with GEC & development agendas and their donor communities.
Science Agendas
Development Agendas
Policy Makers
Resource Managers
Science
Natural
Socio-economic
ESSP is a joint initiative of
WCRP


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
GLOBAL CHANGE


Thank you for your attention!
GLOBAL CHANGE

Hokkaido University International Symposium on Sustainable Development
Plenary Session 1: Monday August 7, 2006 / 10:40am-11:20am
Speaker

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 $C^2GCR \rightarrow$ GEC3 (2004)

Recent Collaborators:

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

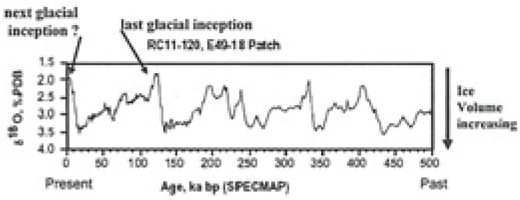
- Others at McGill: A. Antico, A. Jahn, J.-F. Lemieux, B. Papa, N. Roulet, J. Sedláček, G. Smith, K. Wright

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 CO_2); 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

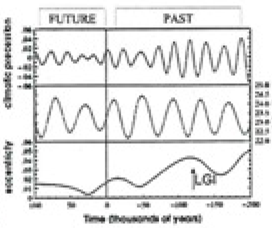
The Orbital Parameters

- 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 kyr and 100 kyr T = 41 kyr T = 25.7 kyr

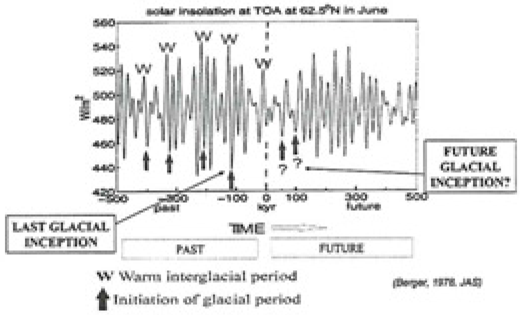
The Milankovitch theory of glacial inception

- 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).



(Berger, 1978, JAS)

The natural evolution of climate

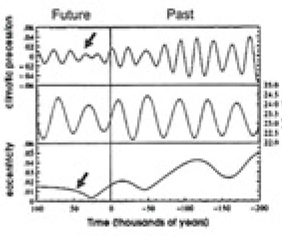


(Berger, 1978, JAS)

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.



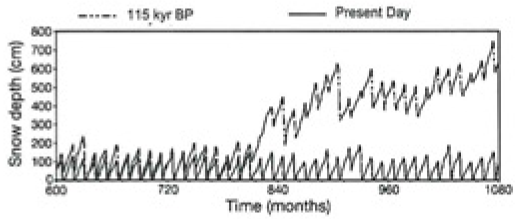
3. Modelling work on the last glacial inception

<u>AGCMs with Milankovitch forcing</u> (and prescribed atmospheric CO_2); time-slice runs:

- de Noblet et al. (1996, GRL)
- Gallimore and Kutzbach (1996, Nature) } Showed vegetation important
- Pollard and Thompson (1997, Ann. Glaciol.) } Ice sheet growth too small
- 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)



<u>EMICs with Milankovitch forcing</u> (and prescribed CO_2); transient runs:

Without vegetation:

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  - Used the 5-component geophysical MPM
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With vegetation:

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  - 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

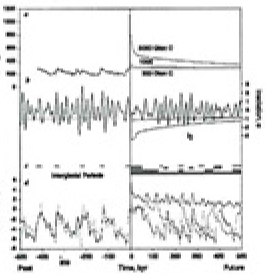
<u>EMIC transient runs with vegetation continued</u>:

- 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:

1. An important time-slice investigation which looked at the role of vegetation on temperature and sea-ice cover:
   - Meissner et al. (2003, Clim. Dyn.)
2. In all the above references, the **<u>atmospheric CO_2 was prescribed.</u>**

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



•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

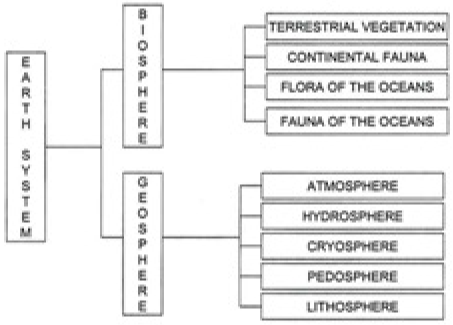
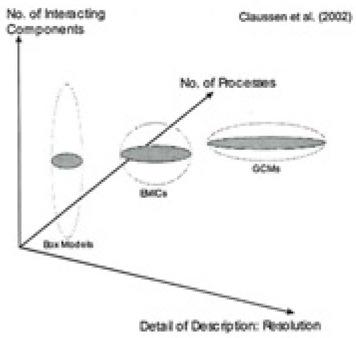


Table of EMICs (Claussen et al., 2002)

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

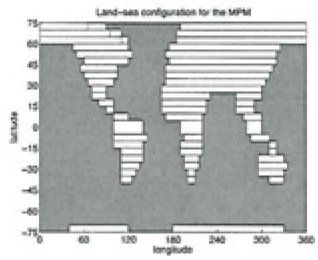
Interactive components of the climate system being implemented into EMICs (Claussen et al., 2002)

Model	Atmos.	Ocean	Biosph.	Sea ice	Inland ice
1	[illegible]	[illegible]	[illegible]	T	
2	[illegible]	[illegible]	[illegible]	TD	[illegible]
3	[illegible]	[illegible]		T	
4	[illegible]	[illegible]	[illegible]	TD	
5	[illegible]	[illegible]		T	
6	[illegible]	[illegible]		TD	[illegible]
7	[illegible]	[illegible]	[illegible]	T	
8	[illegible]	[illegible]	[illegible]	TD	[illegible]
9	[illegible]	[illegible]	[illegible]	TD	
10	[illegible]	[illegible]		TD	[illegible]
11	[illegible]	[illegible]	[illegible]	T	



Land-Sea configuration in the MPM

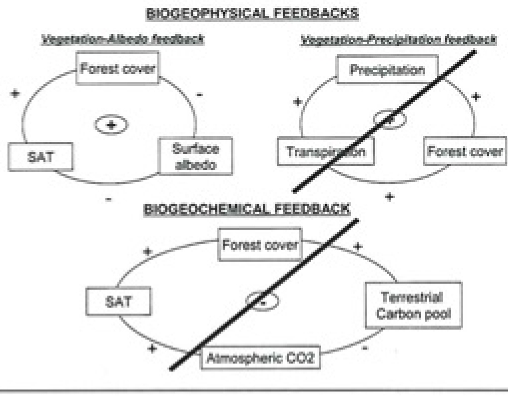
(Wang and Mysak, 2000)



- 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: $\alpha_{Sfree} = \underbrace{f_t \alpha_t}_{trees} + \underbrace{f_g \alpha_g}_{grass} + \underbrace{f_d \alpha_d}_{desert}$



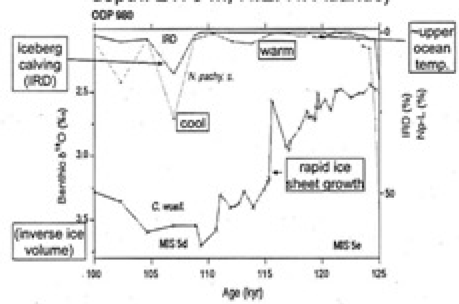
5. Simulation of the last glacial inception with the MPM

- 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)

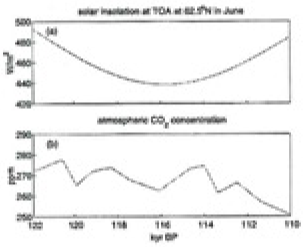


Jerry McManus, pers. comm. (2002)

External forcing used in the geophysical MPM

(Wang and Mysak, 2002)

- Variable solar insolation calculated by realistic orbital parameter changes (Berger, 1978).
- Vostok atmospheric CO_2 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.

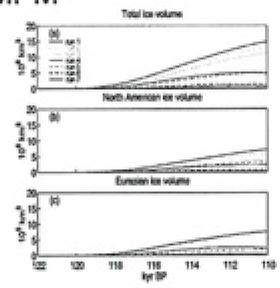


Figure 2. Simulated ice volume growths.

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.

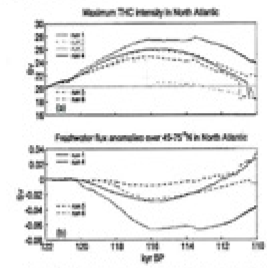


Figure 3. The maximum THC intensities and freshwater flux anomalies.

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

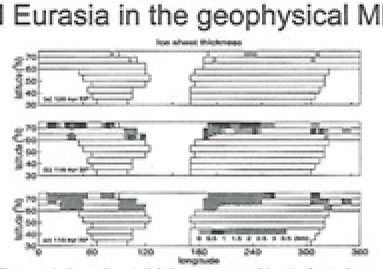
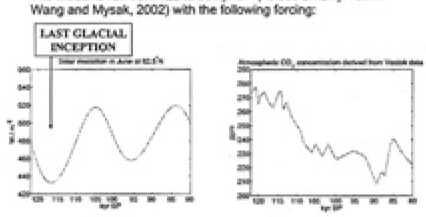


Figure 4. Ice sheet thickness over North America and Eurasia for run 1 (control run) at 120 kyr BP (a), 116 kyr BP (b), and 110 kyr BP (c).

Simulation of glacial inception in the "green" MPM

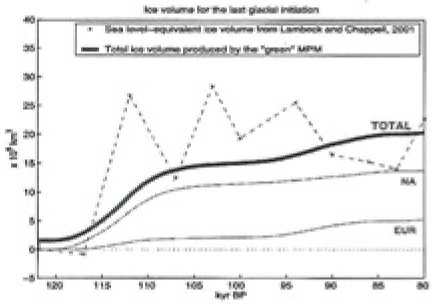
(Cochelin, 2004, MSc thesis; Wang et al., 2005, GRL)

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

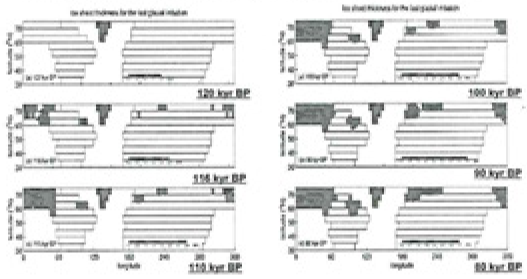


- We want to observe the changes in the climate simulation, due to the addition of the vegetation.

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

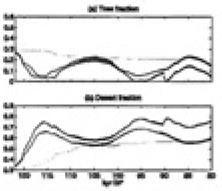
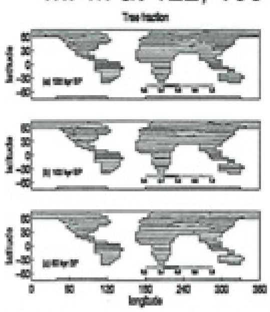


Figure 3. (a) Tree fractions in total land (including ice sheets) and (b) desert fractions in total land (including ice sheets), averaged between 60 and 75°N, for the control experiment (red), the experiment with fixed SAT (green) and the experiment with fixed precipitation (blue) in the vegetation component.

- 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 predominately drives vegetation in high northern latitudes.*

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



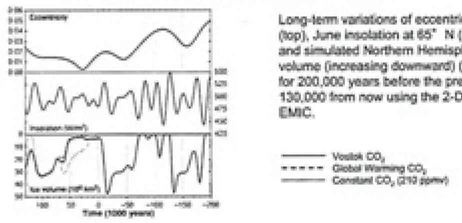
- As the ice sheets buildup, the trees progressively disappear and give way to desert in the high northern latitudes.
- In the high northern latitudes, the treeline has shifted southward by 5° to 10° lat.
- The changes in vegetation and the associated changes in surface albedo contribute to the expansion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

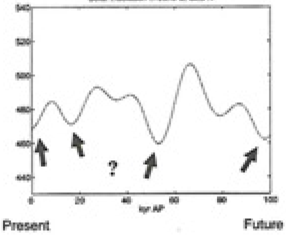
- Loutre and Berger (2000, Clim. Change)
- Berger and Loutre (2002, Science): "An Exceptionally Long Interglacial Ahead?"



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.

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 CO_2 levels and Milankovitch forcing.

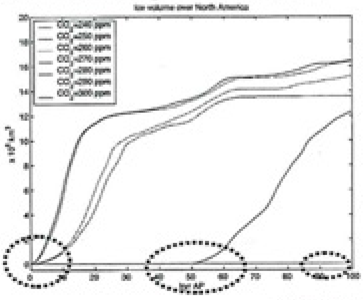


Solar insolation in June, at 62.5° N

When will the next glaciation occur?

Simulation of the next glacial inception

- **Simulations with constant CO_2 concentrations:** 240, 250, 260, 270, 280, 290 and 300 ppm.



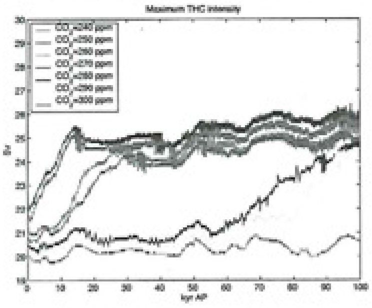
240 – 270 ppm

ICE VOLUME GROWTH

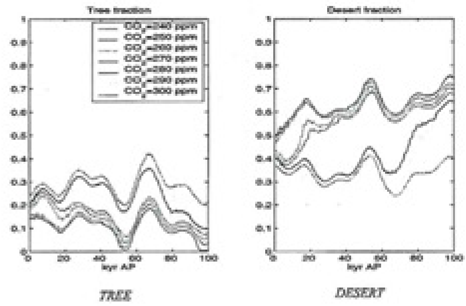
280 – 290 ppm

≥ 300 ppm

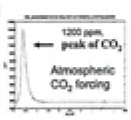
Simulation of the THC behaviour for the next 100 kyr



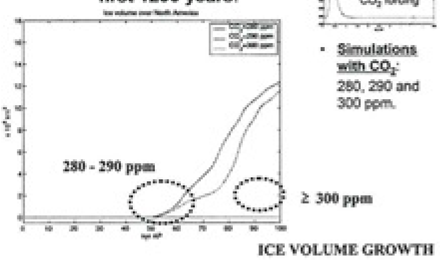
Tree and desert fractions at high latitudes for the next 100 kyr



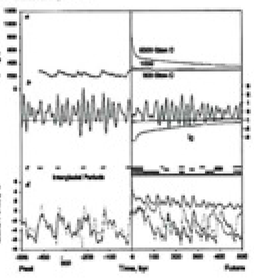
Simulation of the next glacial inception when a WARMING EPISODE is included during the first 1200 years.



- **Simulations with CO_2:** 280, 290 and 300 ppm.

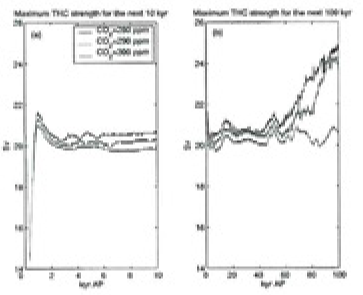


Archer and Ganopolski (2005, G³): Simulation of past and future (?) glacials using an EMIC with an interactive carbon cycle.

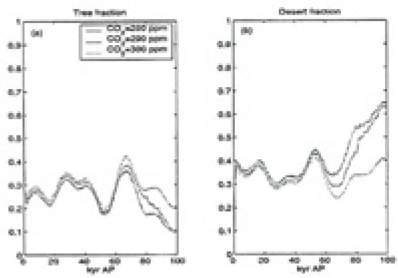


- The 300 GtC anthropogenic input (in blue) corresponds to our prescribed lower-level CO_2 concentrations for which glaciation was simulated after 50 kyr AP.
- The 1000 GtC anthropogenic input (in orange) corresponds to our higher-level CO_2 concentration (≥ 300 ppm) for which glaciation was simulated after 100 kyr AP.
- The 5000 GtC anthropogenic input (in red) produces the "Anthropocene", a period of no future glaciations.

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,
  1. The next glacial inception occurs in the "green" MPM at around 50 kyr AP if atmos. CO_2 lies between 280 and 290 ppm;
  2. For a lower CO_2 level, glacial inception is imminent;
  3. For a higher CO_2 level, no inception will occur during the next 100 kyr.
- If a global warming episode is included and the atmospheric CO_2 level asymptotes to a constant value after 5 kyr, cases 1. and 3. still apply.

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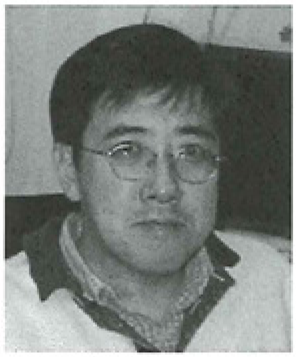
Speaker

Ecological Constraints on System Sustainability*

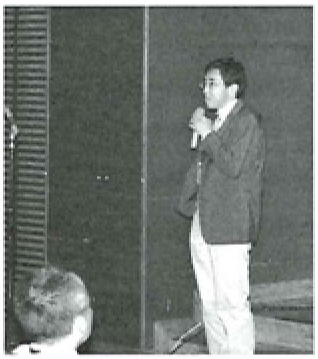


Takashi Kohyama

Professor
Section of Environmental Biology
Faculty of Environmental Earth Science, Hokkaido University
E-mail: kohyama@ees.hokudai.ac.jp

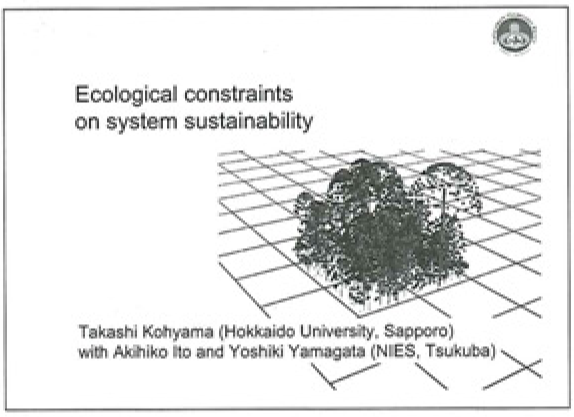
The anthropogenic biosphere is a complex adaptive system, constrained by a variety of processes, of which typical spatial-temporal scale is different from each other. In this lecture, I show the need of multi-scale analysis of system change, taking an example of forest ecosystems. I also propose that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

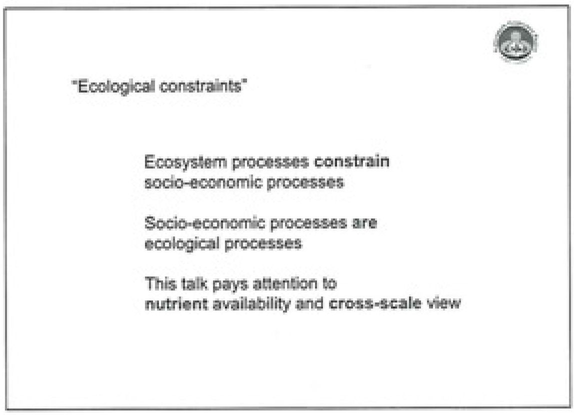
We carried out a synthetic investigation of forest ecosystems in eastern Monsoon Asia. The target area is characterized by the continuous forested biomes from tropic to subarctic zones under prevailing humid climate. We made challenge to link physiological processes of foliage canopy to landscape-scale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

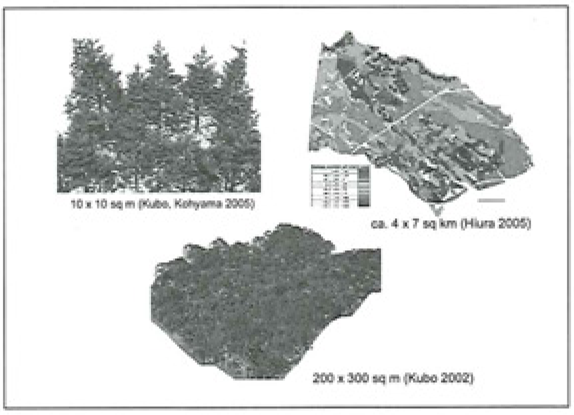


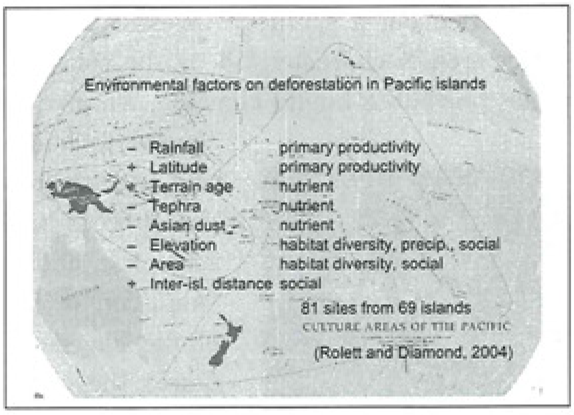
Ecosystem modeling uses such procedure to deal with biological units with naturally variable sizes such as biological individuals, species populations, etc. This situation is somewhat similar to social systems, where available statistic data is arranged with municipal/state/country basis with a variable 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.

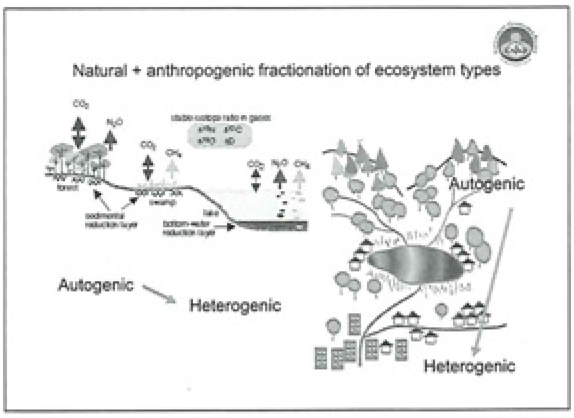
* This paper has been prepared in collaboration with Akihiko Ito and Yoshiki Yamagata of National Institute for Environmental Studies, Tsukuba, Japan.

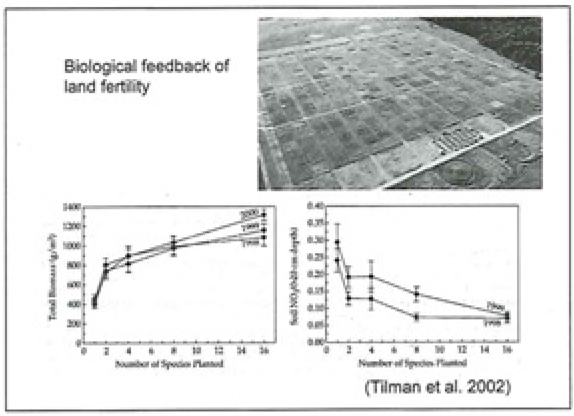












Natural + anthropogenic geochemical transportation

Running off
Leaching
Dust translocation
Guano transportation
...

+

Fertilizer trade
Food/fiber trade
Garbage transport

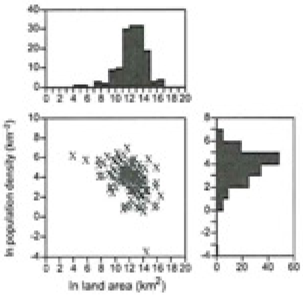
Social/political statistics
social unit basis

Mesh data per unit area
Coupled GCM's

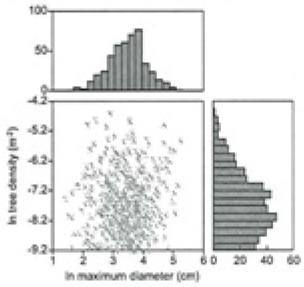
Social/political unit-based analysis

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

Country variation in land area and population size

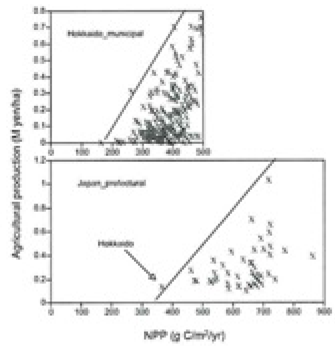


Tree species variation in abundance and maximum size

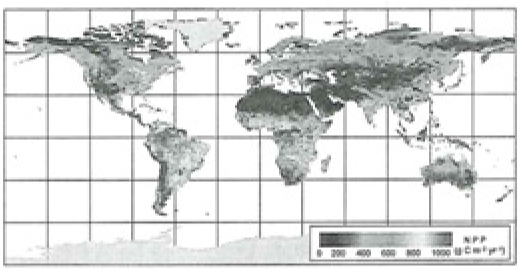


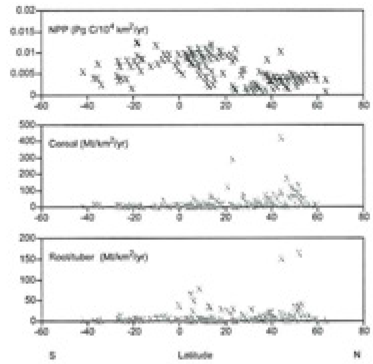
Pasoh 50-ha plot, Malaysia; CTFS, FRIM, AA Harvard Univ.

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

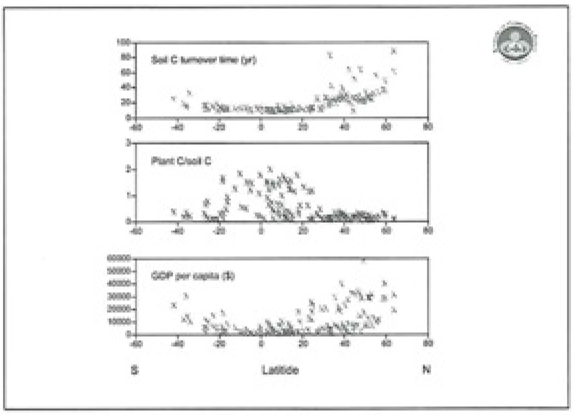


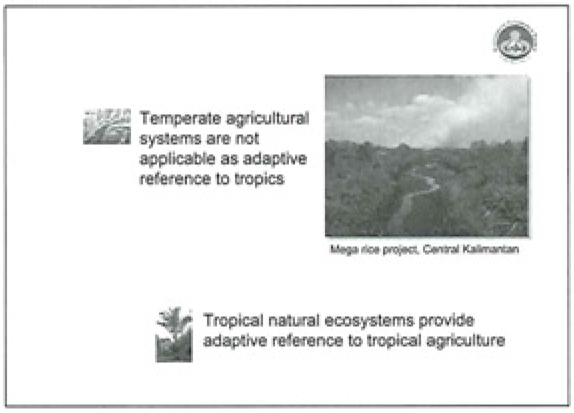
NPP and C storage in mesh map by SimCYCLE
Nation averaging and merging with socio-economic data

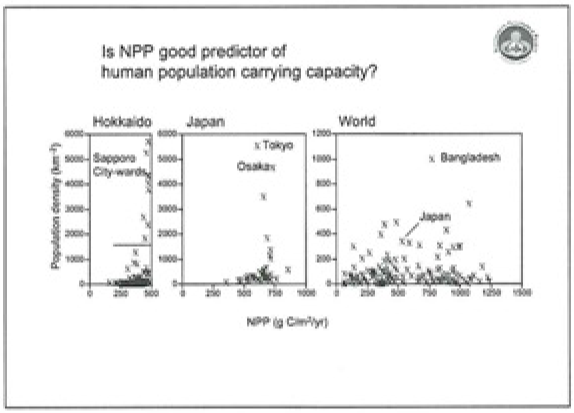


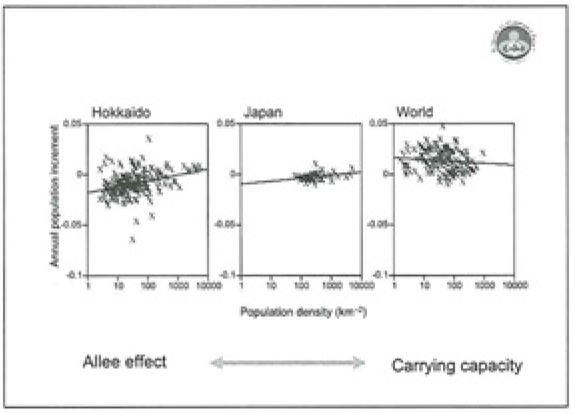



Biomass
NPP
Soil C


Soil C turnover time (yr)
Plant C/soil C
GDP per capita ($)
S
Latitude
N

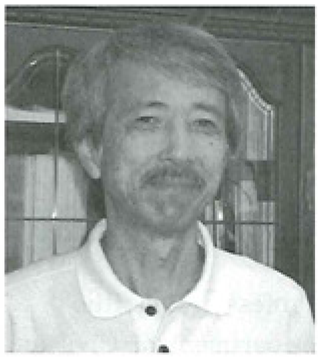

Temperate agricultural systems are not applicable as adaptive reference to tropics
Mega rice project, Central Kalimantan
Tropical natural ecosystems provide adaptive reference to tropical agriculture


Is NPP good predictor of human population carrying capacity?
Hokkaido
Japan
World
Sapporo City-wards
Tokyo
Osaka
Bangladesh
Japan
Population density (km⁻²)
NPP (g C/m²/yr)


Hokkaido
Japan
World
Annual population increment
Population density (km⁻²)
Allee effect
Carrying capacity


Cross-scale view
サステイナビリティ・ガバナンス プロジェクト
Global Land Project (GLP)
– Sapporo Nodal Office –

Summary of Plenary Session 1: Sustainability of the Earth System



Chaired by **Motoyoshi Ikeda**

Professor
Faculty of Environmental Earth Science, Hokkaido University
E-mail: mikeda@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

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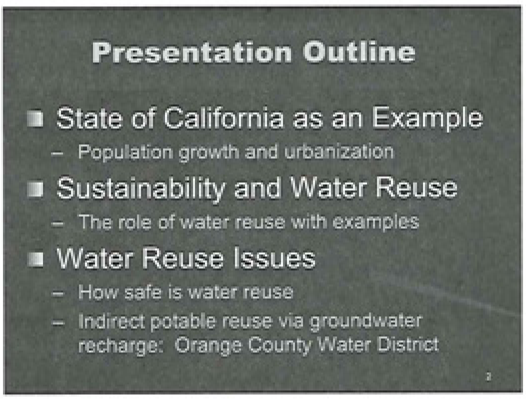
The sustainability of water resources is of particular importance in light of projected increases in global population. It has been reported that the current world population of 6.2 billion is increasing at a rate of about 1.2 percent per year (United Nations, 2003) with the highest rates of population 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.

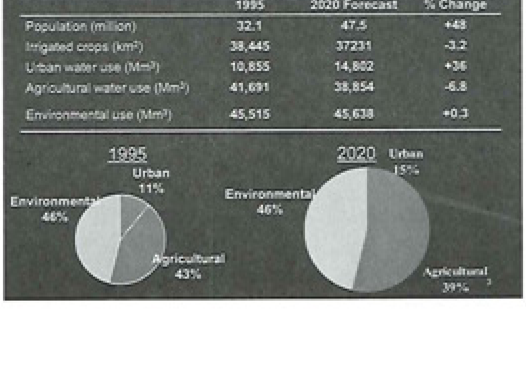
For water supplies to be sustainable, the rate at which water is withdrawn from water sources needs to be in balance with the rate of renewal or replenishment of these water sources. In addition to a balance of water quantity, water quality must also be sustainable, recoverable or reusable. Water that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

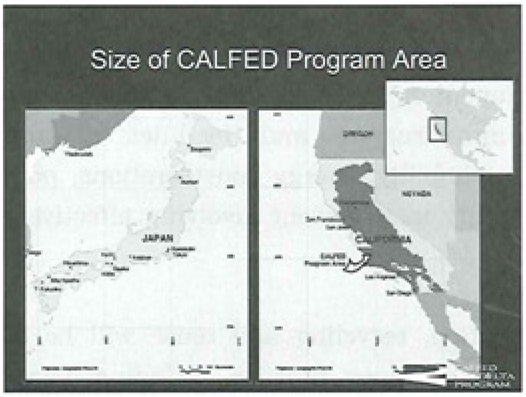
Historically, after water has been used for societal needs, it has been labeled as "waste"water and treated to the extent deemed necessary for discharge into a receiving water or for land disposal. During most of the 20th century, the emphasis of wastewater treatment was on pollution abatement, protection 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 multi-disciplined 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.

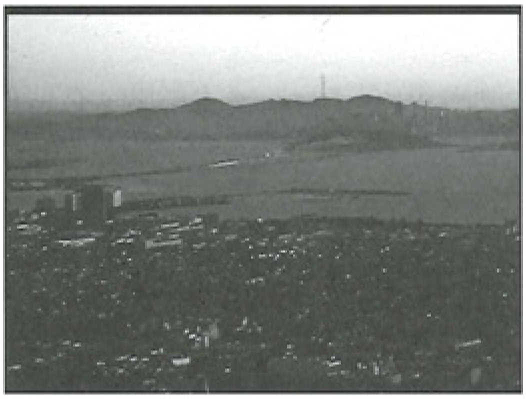
REFERENCE: United Nations (UN Population Division) (2003) *World Population Prospects: The 2002 Revision - Highlights*, United Nations Population Division, Department of Economic and Social Affairs. Accessed at: http://www.un.org/esa/population/unpop.htm

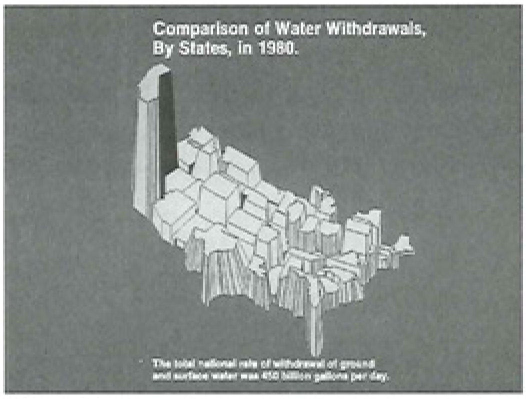


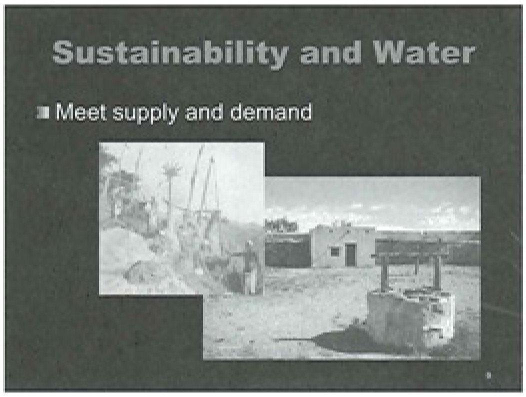


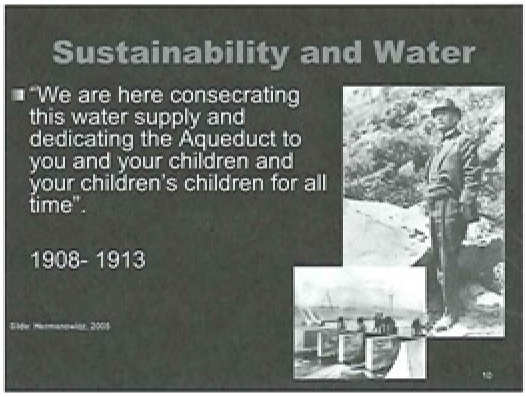

Size of CALFED Program Area
JAPAN
OREGON
NEVADA
CALIFORNIA

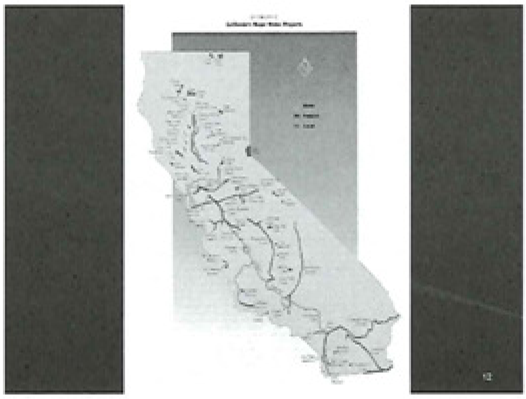

6

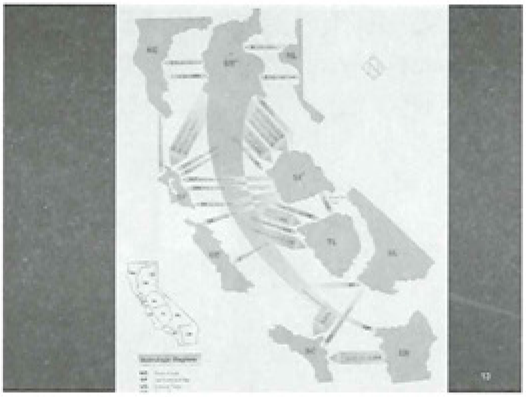


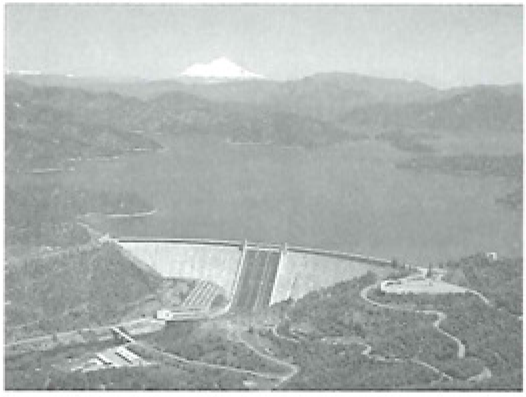

Comparison of Water Withdrawals, By States, in 1980.
The total national rate of withdrawal of ground and surface water was 450 billion gallons per day.

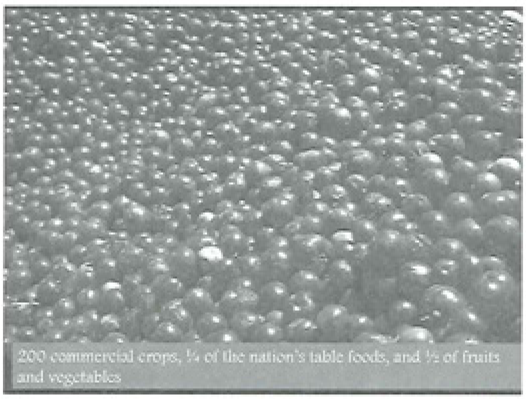

Sustainability and Water
Meet supply and demand
9

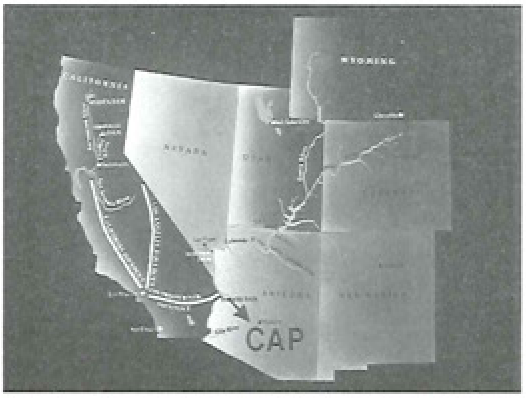

Sustainability and Water
"We are here consecrating this water supply and dedicating the Aqueduct to you and your children and your children's children for all time".
1908- 1913
10

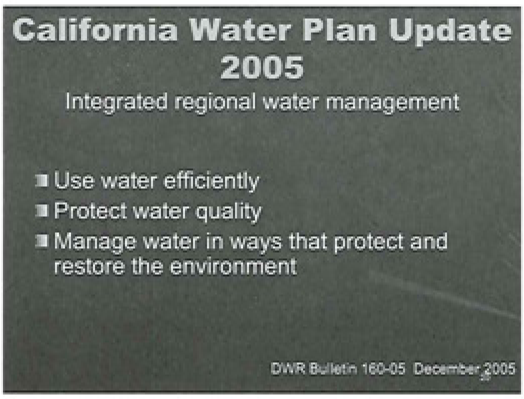

12






200 commercial crops, ¼ of the nation's table foods, and ½ of fruits and vegetables

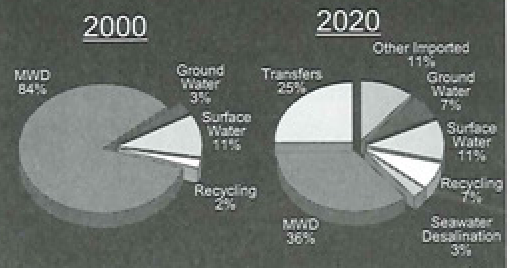

CAP


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

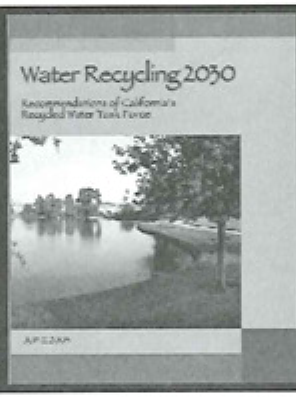
Sustainability and Water

- 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

Regional Water Supply Sources Comparison – San Diego, CA



Task Force Report to the Legislature (June 2003)



WATER REUSE IN THE U.S.A.

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

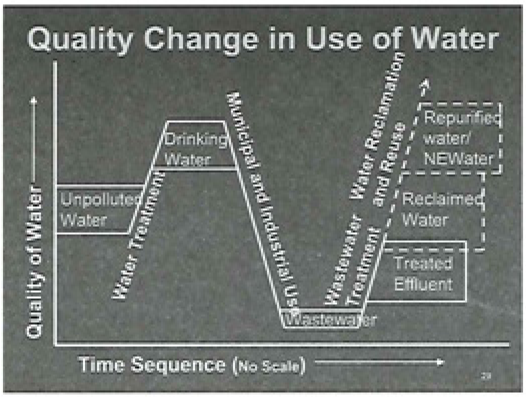
Water Reuse Definitions

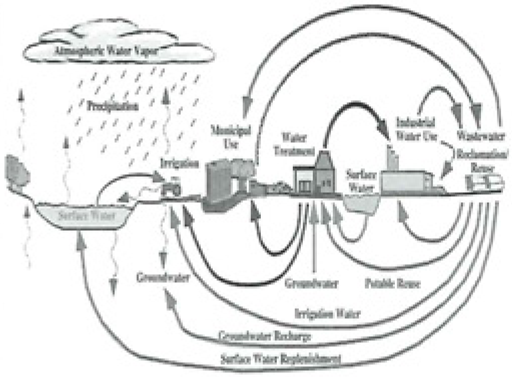
- Wastewater – Used water discharged from homes, business, and cities, e.g. Municipal wastewater (sewage)
- Water reclamation – Treatment or processing of wastewater to make it reusable
- Water reuse – The use of treated wastewater for beneficial use such as agricultural irrigation and industrial cooling

Benefit of Water Reuse

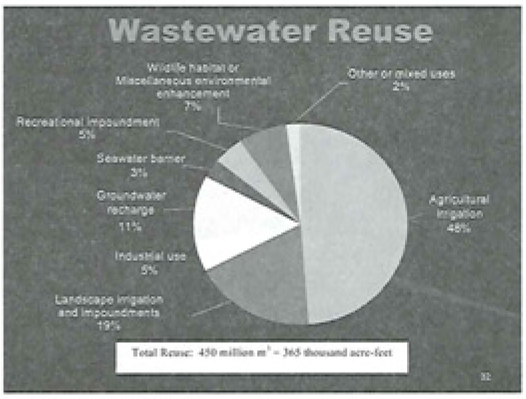
- Important element of integrated water resources management
- Treated effluent is used as a water resource for beneficial purposes
- The wastewater is kept out of streams, lakes, and beaches; thus reducing pollution of surface water and groundwater

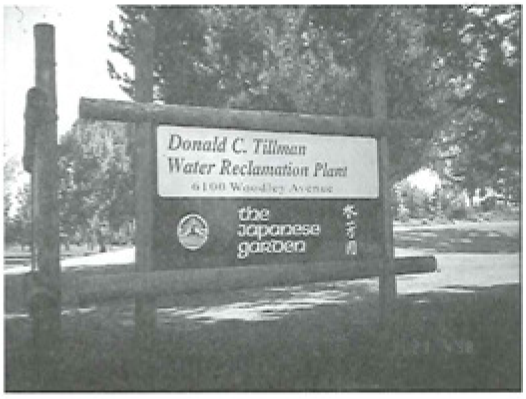
City of Los Angeles Hyperion Wastewater Treatment Plant 1.7 M m^3/d (450 mgd), dedicated on May 15, 1999

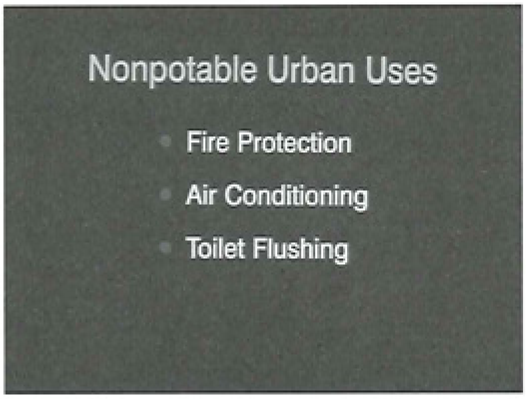

Quality Change in Use of Water
Quality of Water
Unpolluted Water
Water Treatment
Drinking Water
Municipal and Industrial Use
Wastewater
Wastewater Treatment
Water Reclamation and Reuse
Repurified water/ NEWater
Reclaimed Water
Treated Effluent
Time Sequence (No Scale)


Atmospheric Water Vapor
Precipitation
Surface Water
Irrigation
Municipal Use
Water Treatment
Surface Water
Industrial Water Use
Wastewater
Reclamation/ Reuse
Groundwater
Groundwater
Potable Reuse
Irrigation Water
Groundwater Recharge
Surface Water Replenishment


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
Wildlife habitat or Miscellaneous environmental enhancement 7%
Other or mixed uses 2%
Recreational impoundment 5%
Seawater barrier 3%
Groundwater recharge 11%
Industrial use 5%
Landscape irrigation and impoundments 19%
Agricultural irrigation 48%
Total Reuse: 450 million m³ = 365 thousand acre-feet


Donald C. Tillman
Water Reclamation Plant
6100 Woodley Avenue
the japanese garden


Nonpotable Urban Uses
Fire Protection
Air Conditioning
Toilet Flushing

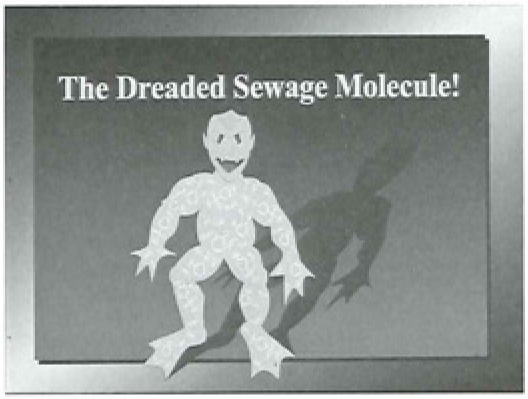

42

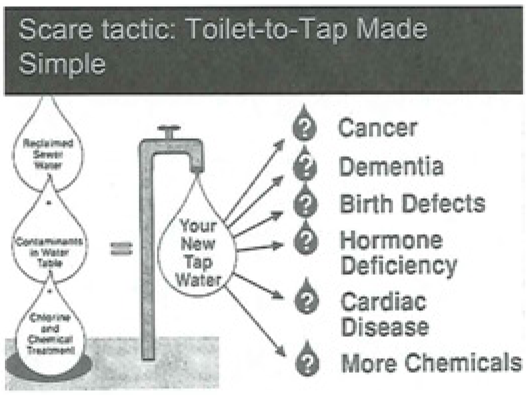
INDIRECT POTABLE REUSE

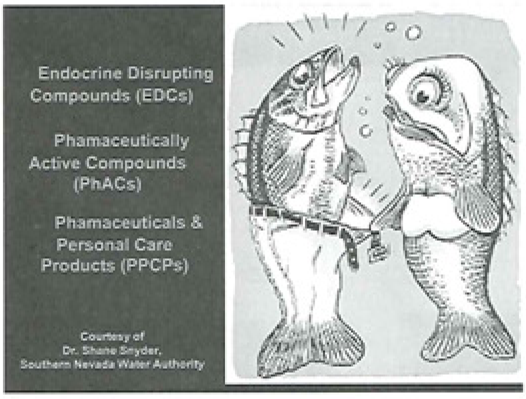
via groundwater recharge

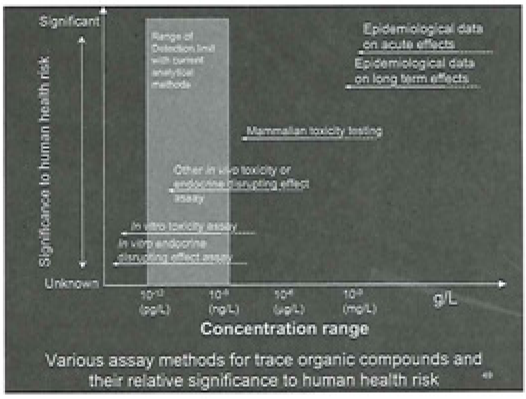
- Regulatory Framework—1996
- Groundwater Recharge Criteria—2003
  - Control of pathogens and trace organics

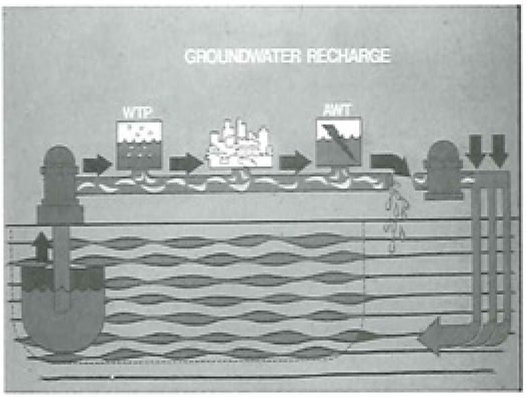
- Spreading:
  - Disinfected Tertiary Treatment
  - 6- Month Retention
  - 150 m (500 ft) Distance
- Injection:
  - Disinfected Advanced Treatment
  - 12-Month Retention
  - 600 m (2,000 ft) Distance







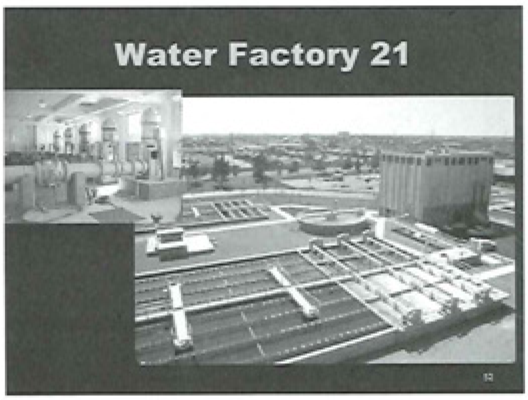




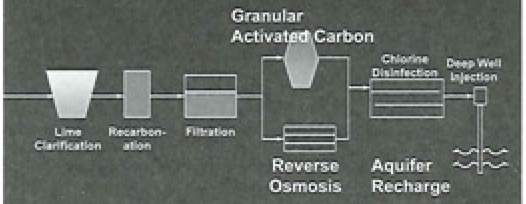
Orange County Water District

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 x 10^3 m^3/d (15 mgd)
- Groundwater Replenishment (GWR) System, 236 (473) x 10^3 m^3/d $487 Million project; O&M annual cost $26 million, opens 2007.



Water Factory 21

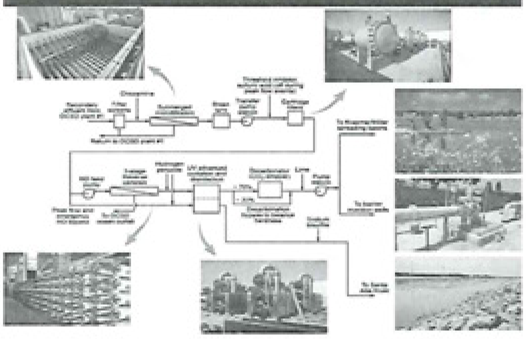


1976 - 2000
21 Mm^3/ yr (15 mgd)

What is the Groundwater Replenishment System?

- Indirect potable reuse project
  - Phase I — 236 x 10^3 m^3/d
  - Ultimate Capacity — 473 x 10^3 m^3/d
- Treatment: 100% MF, RO & UV + H_2O_2
- 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

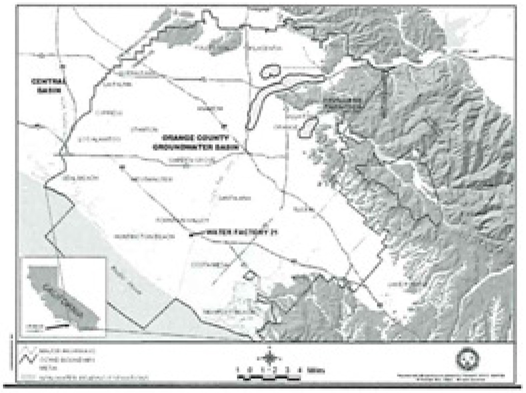
GWRS being constructed



Energy requirement for water delivery to Orange County

Various water sources	Energy requirement, kWh/m3
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

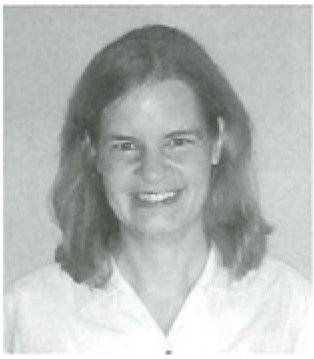
■ **RECYCLED DRINKING WATER:**

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.

Hokkaido University International Symposium on Sustainable Development
Plenary Session 2: Monday August 7, 2006 / 1:40pm-2:20pm
Speaker

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



Miranda Schreurs

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Department of Government and Politics
University of Maryland, U.S.A.
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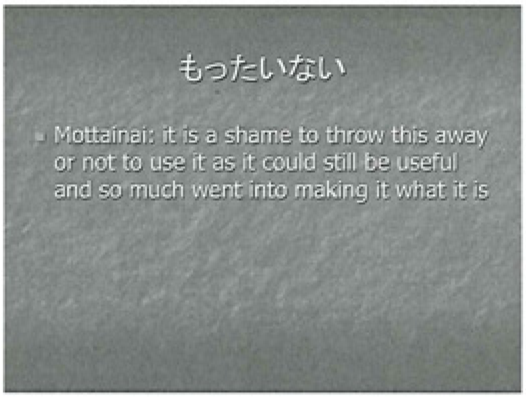
Consumer societies are being faced by increasingly difficult and pressing problems related to waste management. Household waste contains an increasingly large share of electronic products--computers, televisions, DVDs--that have added new challenges for municipalities that already have great difficulties 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.



Wangari Mattai, 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

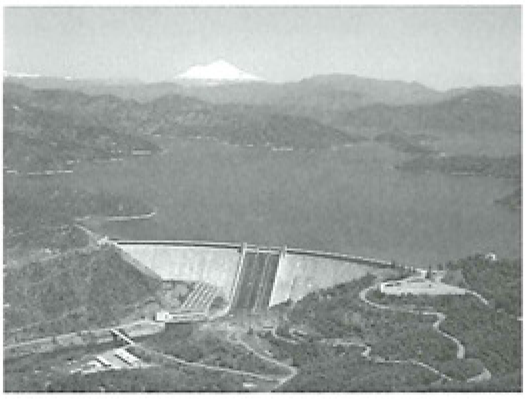
Amended 1986 to address underground tanks storing petroleum and other hazardous substances

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

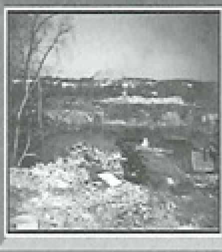
Lois Gibbs and the Love Canal Home Owners Association



SUPERFUND

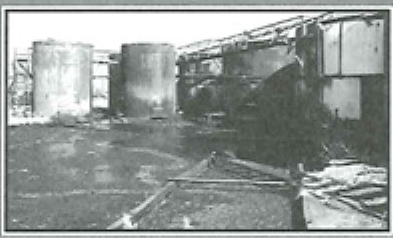
- Provides a federal superfund for the clean-up of abandoned hazardous waste sites as well as accidents, spills, and other emergency releases of pollutants
- Makes a broad class of parties strictly liable for clean up costs for releases of hazardous substances

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



Hidden dangers

1984 Bhopal: The world's worst chemical disaster

BBC pictures

Bhopal

Dec 3, 1984 –

- Union Carbide Co. fertilizer plant leaks methyl icocyanide
- 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	[illegible]	DICKERSON	2038708
2	[illegible]	ROCKVILLE	547
3	[illegible]	ROCKVILLE	510
4	[illegible]	DICKERSON	250
5	[illegible]	GAITHERSBURG	11
6	[illegible]	GAITHERSBURG	8
7	[illegible]	GERMANTOWN	0

States with Animal Waste (TRI)

Rank	State	Tons of Waste in 1992
1.	TEXAS	110,000,000
2.	CALIFORNIA	55,000,000
3.	IOWA	51,000,000
4.	NEBRASKA	47,000,000
5.	KANSAS	46,000,000
6.	WISCONSIN	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

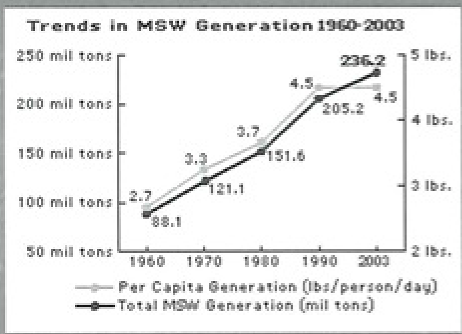
Earth 911

- 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

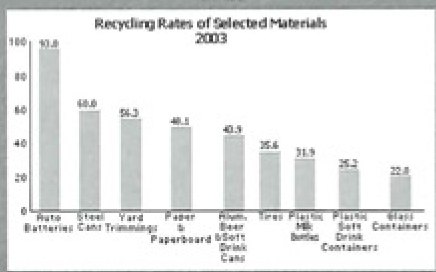
EPA data



US municipal solid waste generation (EPA data)

EPA graphic

EPA data



U.S. Cities Recycling Rates

(Waste News 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

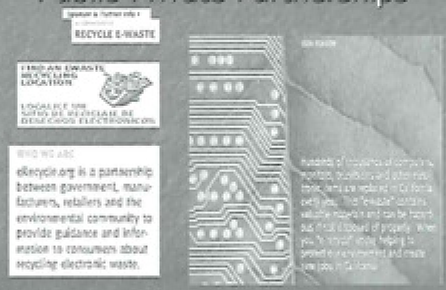
1998 Federal Acquisition, Waste Prevention, and Recycling Exec. Order

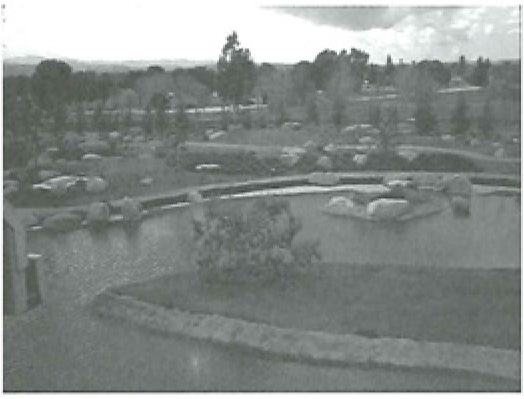
The US Federal government has limited its role in household recycling and producer packaging matters to education and promoting voluntary initiatives

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 entitites
-recommend env'lly 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
- Portugal 440
- Sweden 470
- Italy 510
- France 530
- UK 580
- Germany 590
- Spain 650
- Switzerland 660
- Australia 690
- USA 730

Planet Ark: Recycling Olympics Paper and Cardboard

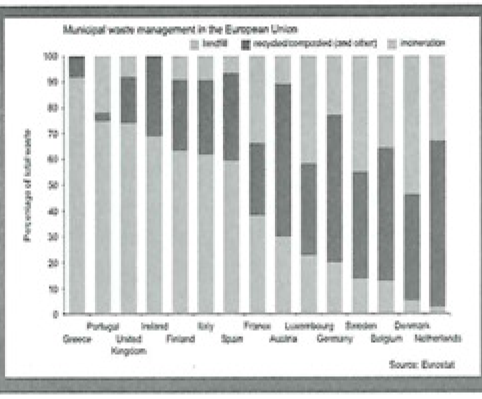
- Germany 70%
- Sweden, Switz 63%
- Japan 59%
- France 50%
- Spain 48%
- Australia 47%
- Portugal 46%
- USA 42%
- UK 41%
- Italy 37%

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

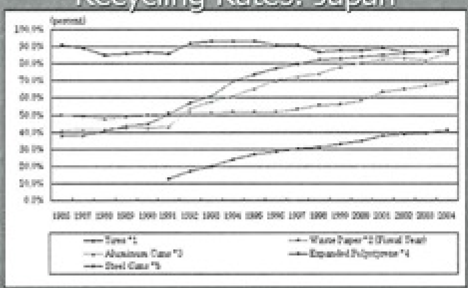
Japan: Catching up & Surpassing the EU?

- 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!

Hokkaido University International Symposium on Sustainable Development
Plenary Session 2: Monday August 7, 2006 / 2:20pm-2:50pm
Speaker

Sustainable and Cyclical Economy of Asia: Overview

Fumikazu Yoshida

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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.

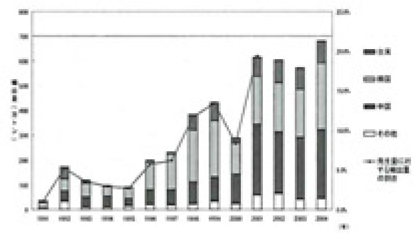
Sustainable and Cyclical Economy of Asia: Overview

Fumikazu Yoshida
Hokkaido University

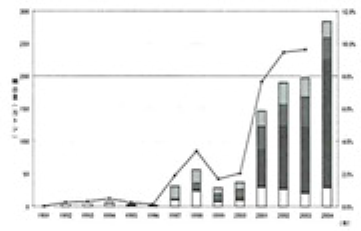
Cross-Border Resource Cycling

- 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.

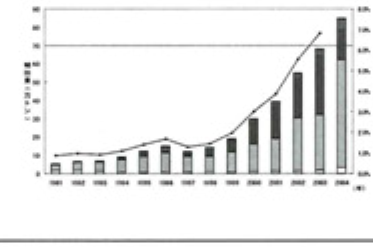
Cross-Border Resource Cycling Ferrous scrap exports and importing countries from Japan



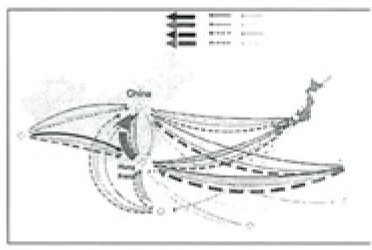
Waste paper exports and importing countries from Japan



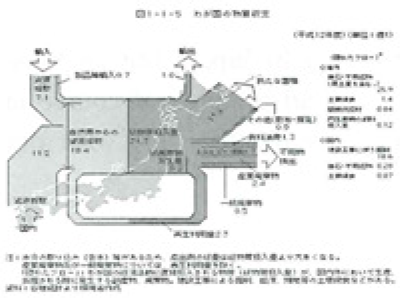
Plastic scrap exports and importing countries from Japan



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



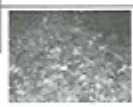
Japan's Material Flow



PET Bottle Kojima.M@ppt

Europe

Compressed to bale



Philippines

Shredded and washed to flake

Washed flake of PET.

China

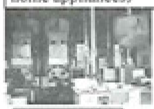
It twists and unite to make thick thread.

Thread is spun with heat.

Expanded Polystyrene Kojima.M@ppt

JAPAN

Expanded Polystyrene (box for fish and home appliances)



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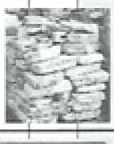
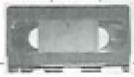


Consumption

China

Making re-pellet

Making case of video tape and a part of CD case

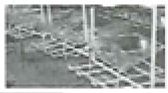


Consumption

Glass Cullet from CRT Kojima.M@ppt

Consumer → Export as Secondhand is not under Basel

Dismantling Factory for TV and Computer



Unwashed Glass Cullet

Factory Washing Glass Cullet

Washed Glass Cullet

Germany => Czech Rep. (not under Basel)

Glass Manufacturer

Glass for CRT

CRT Manufacturer or TV Manufacturer

Loss (unwashed glass cullet)

Singapore => Japan, Thailand (Under Basel)

Computer Kojima.M@ppt

Malaysia, Singapore

Dell is collecting discarded computer from their customer

South Korea

Refinery to extract metals from Printed Circuit Board

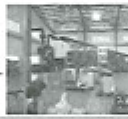
Making CRT glass from glass cullet

Philippines

An e-waste recycling factory dismantle computer.

<- Sorting out Printed circuit board

The crusher of CRT glass.



Copy Machine collected by Fuji Xerox in Asia and Pacific Kojima.M@ppt

Australia, Indonesia, Malaysia, Philippines, New Zealand, Singapore, South Korea, Hong Kong and Thailand

Fuji Xerox is collecting discarded copy machine and toner cartridge from their customer

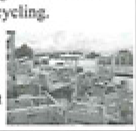
Japan

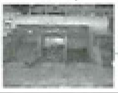
Material recycling and proper disposal.

Thailand

Fuji Xerox established factory dismantling copy machine for recycling and toner cartridge for reuse of parts and recycling.

Most of parts are recycled in Thailand, but some of them are sent to Japan





Thailand

Factory washing monitor glass

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

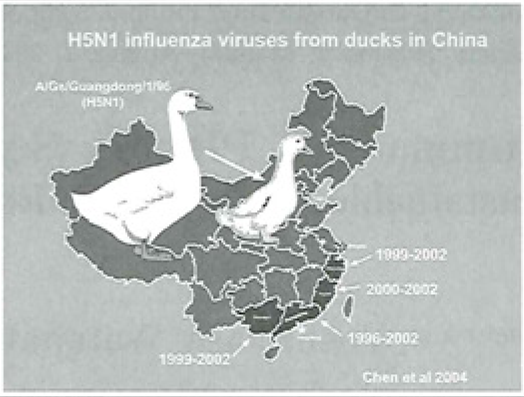
Pollution from Recycling of Imported Waste Kojima.M@ppt

- 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.

IC chips are removed from PCB by using heat. (Guiyu, Nov. 2004)

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 we 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.



Second:Basel Convention

- **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: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

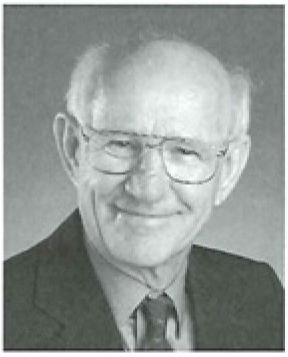
The sustainability of water resources is of particular importance in light of projected increase in global population. For water supplies to be sustainable, the rate at which water is withdrawn from water sources needs to be in balance with the rate of renewal or replenishment of these water sources. 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.

Hokkaido University International Symposium on Sustainable Development
Plenary Session 3: Monday August 7, 2006 / 2:55pm-3:35pm
Speaker

Origin and Evolution of Influenza Virus



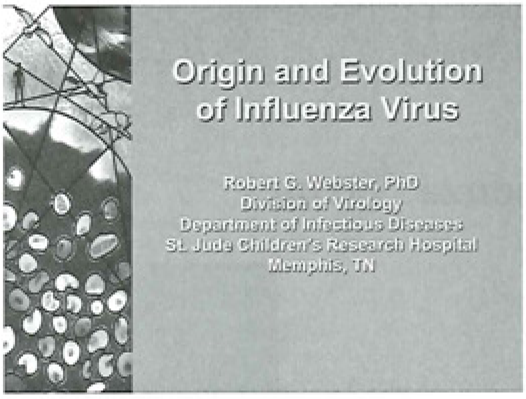
Robert G. Webster

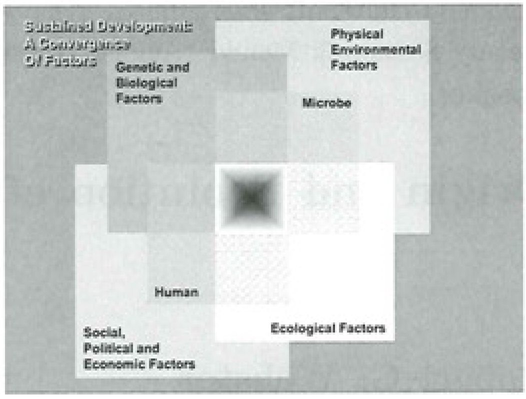
Professor
Division of Virology, Department of Infectious Diseases,
St. Jude Children's Research Hospital, U.S.A.
E-mail: robert.webster@stjude.org

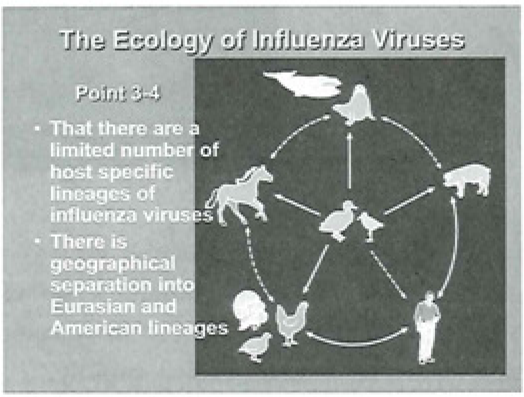
Pandemic influenza is a zoonotic disease caused by the transfer of influenza A viruses or virus gene segments from aquatic bird reservoirs to humans and domestic animals. In wild aquatic birds - the natural hosts of all influenza viruses - these viruses exist in harmony with their natural host. After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

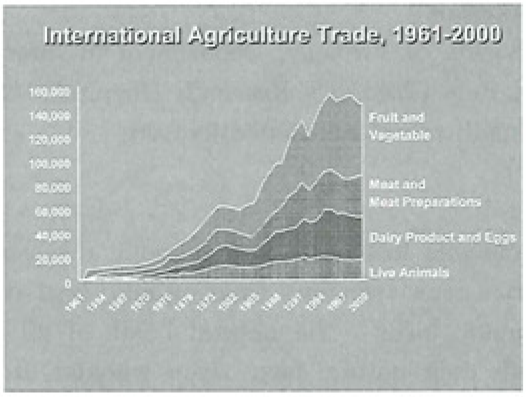
In the past century there have been three pandemics in humans: 1918 Spanish, 1957 Asian, 1968 Hong Kong. These have emerged after reassortment between human influenza viruses and those in the aquatic birds of the world or directly from avian sources probably via intermediate hosts.

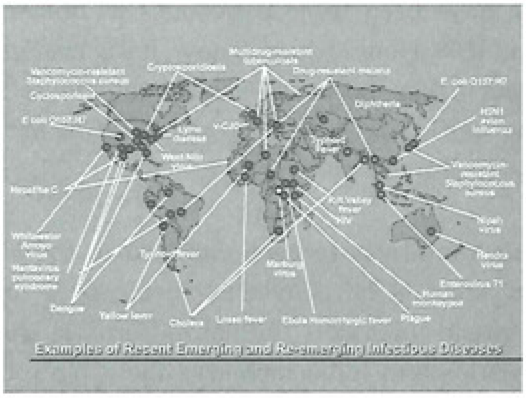
The pandemics of the past century have been confined to the H1, H2 and H3 subtypes but there is no convincing evidence to exclude the others. The spread of H5N1 influenza viruses from Eastern Asia to Europe, Africa and India increases the geographical range and pandemic potential of this virus. Ducks 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.

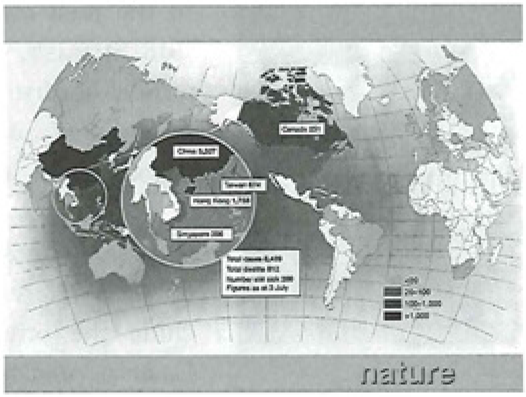

Origin and Evolution of Influenza Virus
Robert G. Webster, PhD
Division of Virology
Department of Infectious Diseases
St. Jude Children's Research Hospital
Memphis, TN

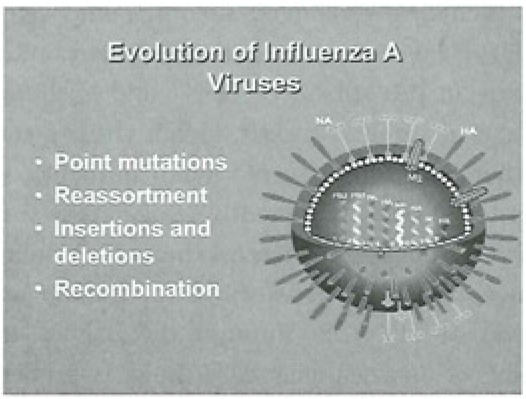

Sustained Development: A Convergence Of Factors
Genetic and Biological Factors
Physical Environmental Factors
Microbe
Human
Social, Political and Economic Factors
Ecological Factors

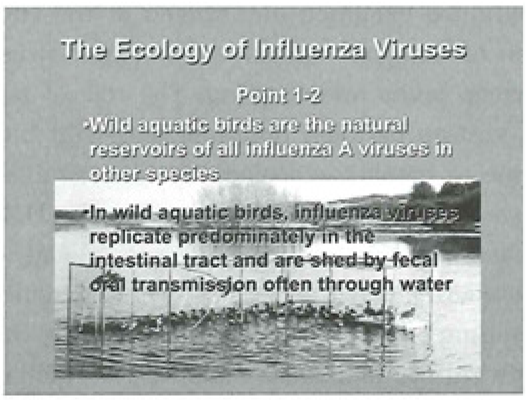

The Ecology of Influenza Viruses
Point 3-4
• That there are a limited number of host specific lineages of influenza viruses
• There is geographical separation into Eurasian and American lineages

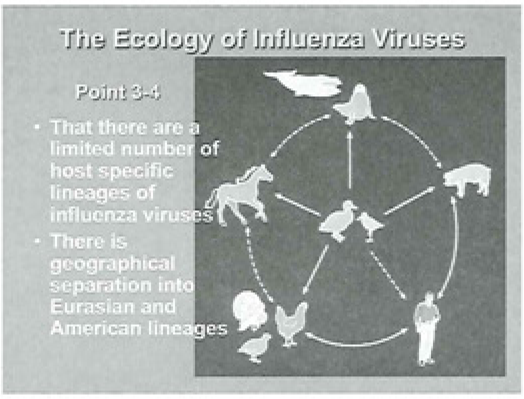

International Agriculture Trade, 1961-2000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Fruit and Vegetable
Meat and Meat Preparations
Dairy Product and Eggs
Live Animals

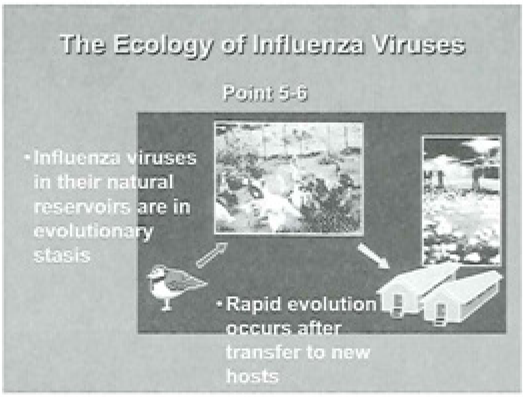

Examples of Recent Emerging and Re-emerging Infectious Diseases
Cryptosporidiosis
Cyclosporiasis
E. coli O157:H7
Diphtheria
Hepatitis C
Lyme disease
West Nile virus
Rift Valley fever
Nipah virus
Hendra virus
Marburg virus
Dengue
Yellow fever
Cholera
Lassa fever
Ebola Hemorrhagic fever
Plague

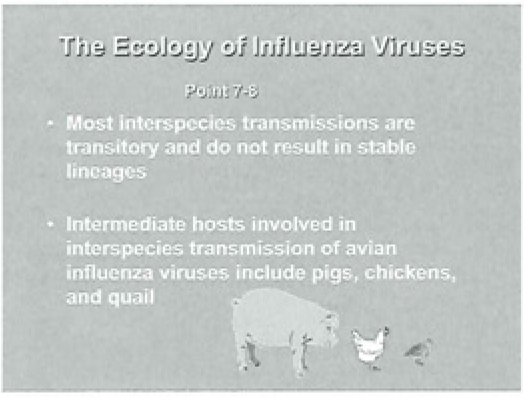

nature

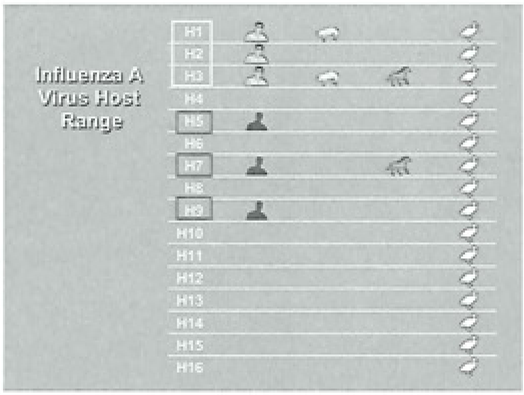

Evolution of Influenza A Viruses
• Point mutations
• Reassortment
• Insertions and deletions
• Recombination
HA
NA
HA

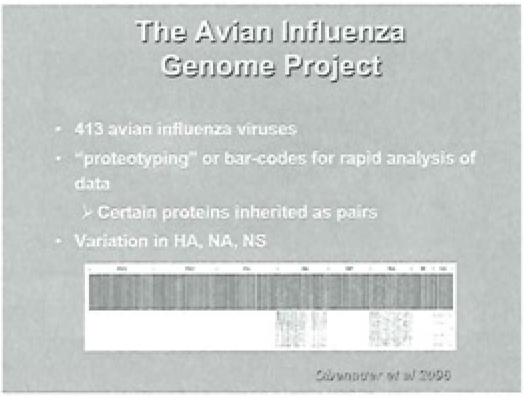

The Ecology of Influenza Viruses
Point 1-2
•Wild aquatic birds are the natural reservoirs of all influenza A viruses in other species
•In wild aquatic birds, influenza viruses replicate predominately in the intestinal tract and are shed by fecal oral transmission often through water

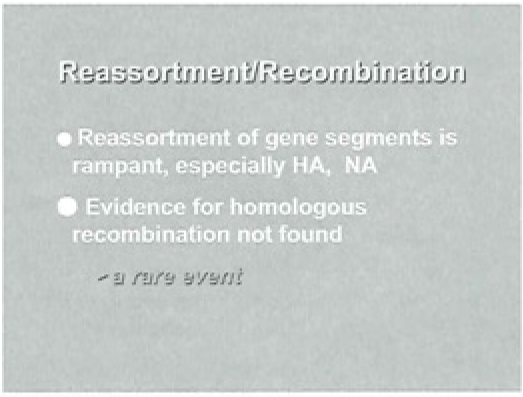

The Ecology of Influenza Viruses
Point 3-4
• That there are a limited number of host specific lineages of influenza viruses
• There is geographical separation into Eurasian and American lineages

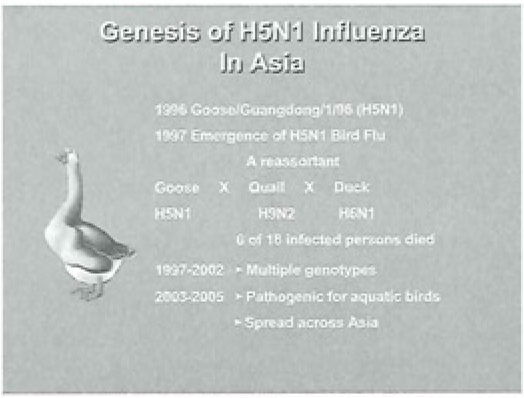

The Ecology of Influenza Viruses
Point 5-6
• Influenza viruses in their natural reservoirs are in evolutionary stasis
• Rapid evolution occurs after transfer to new hosts

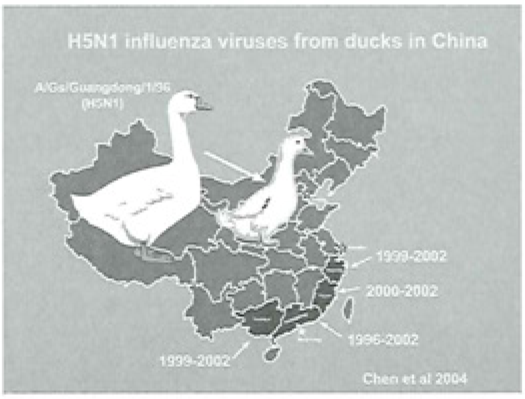

The Ecology of Influenza Viruses
Point 7-8
• Most interspecies transmissions are transitory and do not result in stable lineages
• Intermediate hosts involved in interspecies transmission of avian influenza viruses include pigs, chickens, and quail

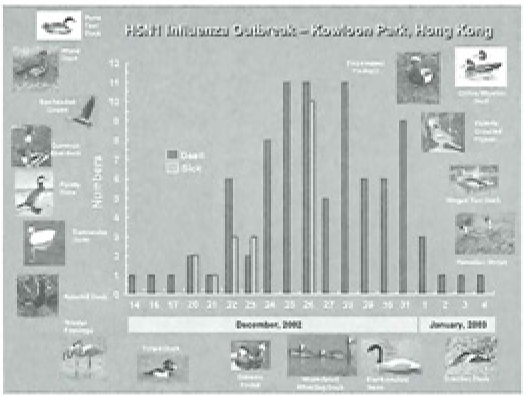

Influenza A Virus Host Range
H1
H2
H3
H4
H5
H6
H7
H8
H9
H10
H11
H12
H13
H14
H15
H16

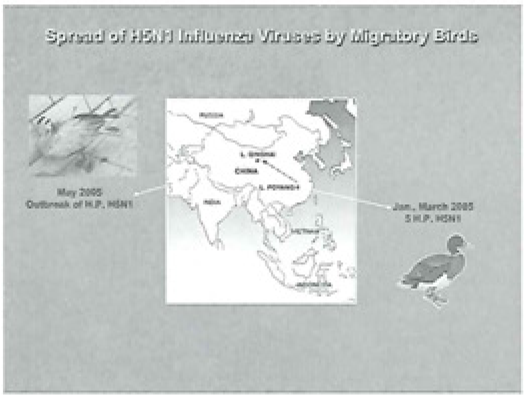

The Avian Influenza Genome Project
• 413 avian influenza viruses
• "proteotyping" or bar-codes for rapid analysis of data
➢ Certain proteins inherited as pairs
• Variation in HA, NA, NS


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 H9N2 H6N1
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
A/Gs/Guangdong/1/96 (H5N1)
1999-2002
2000-2002
1996-2002
1999-2002
Chen et al 2004



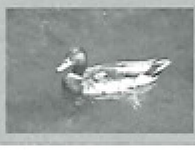


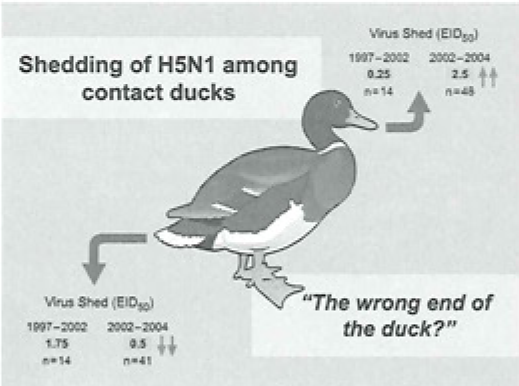
Serological Analysis of Migratory Ducks in China 2005

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



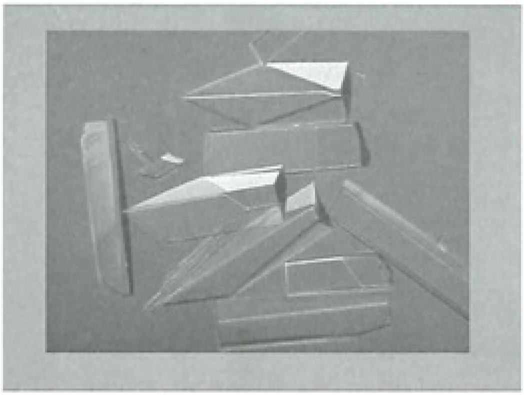


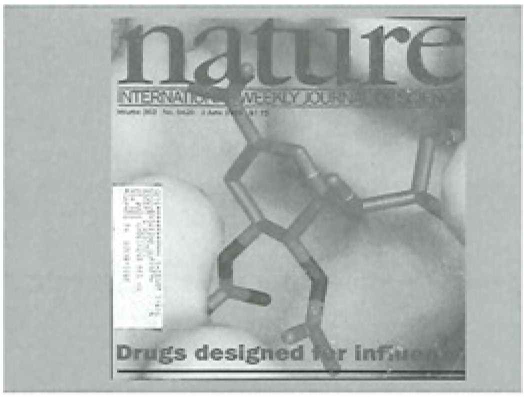
When H5N1 emerged in Southern China in 1996 the current strategy for making anti-influenza drugs and vaccines did not exist

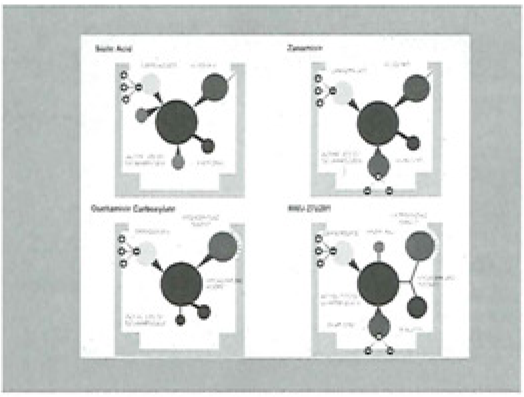
- The importance of sustained development:
  - *Development of anti neuraminidase drugs*
  - *Development of reverse genetics for vaccines and understanding pathogenesis*

Sustained Development

Development of antineuraminidase drugs





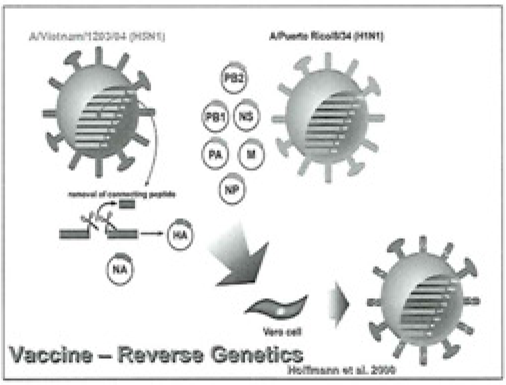


Surveillance to Drug Design

- 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

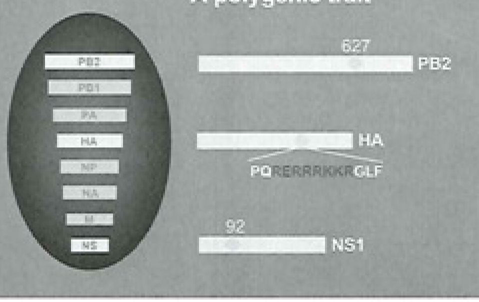
Sustained Development

- Development of Reverse Genetics
- Palese – Kawaoka – Hoffmann



Pathogenesis

A polygenic trait



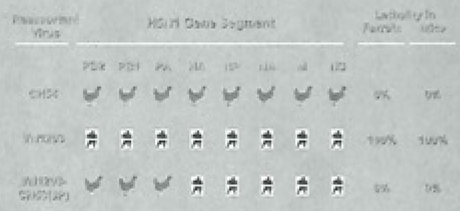
Pathogenicity of H5N1 Isolates in the Following Hosts?

	Chickens	Ducks	Ferrets	Mice
A/VN/1203/04	++++	++++	++++	++++
A/chicken/59/04	++++	-	-	-

Role of HA and NA?

Salomon et al., 2006 JEM

Role of Polymerase Complex Genes?

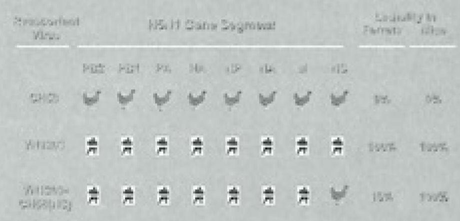


Salomon et al., 2006 JEM

Role of PB2?

Salomon et al., 2006 JEM

Role of NS?



Salomon et al., 2006 JEM

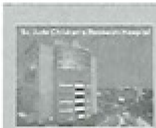
Which Genes of H5N1 are Responsible for Virulence in Mammals?

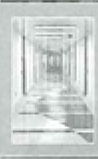
Gene		Amino acid Differences
• PB2	+	4
• PB1	+	3
• PA	+	4
• HA	+	5
• NP	-	1
• NA	+	5
• M	-	1
• NS	+	8

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





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St. Jude Children's Research Hospital
Richard Webby, Elena Govorkova, Erich Hoffmann, Diane Hulse, Katharine Sturm-Ramirez, Aleksandr Lipatov and The Influenza Support Staff

Hong Kong University
Drs. Yi Guan, Malik Peiris, Leo Poon, K.Y. Yuen, Honglin Chen
Influenza Research Group

Indonesian Ministry of Research & Technology
Dr. Amin Soebandrio

Vietnamese Ministry of Agriculture and Rural Health Development
Dr. TD Nguyen

Thailand Bureau of Disease Control and Veterinary Services
Dr. Chantanee Buranathai

Kasetsart University, Kamphaengsaen Campus
Dr. Thaweesak Songserm

Hokkaido University International Symposium on Sustainable Development
Plenary Session 3: Monday August 7, 2006 / 3:35pm-4:05pm
Speaker

Are We Prepared for Emerging Zoonoses?

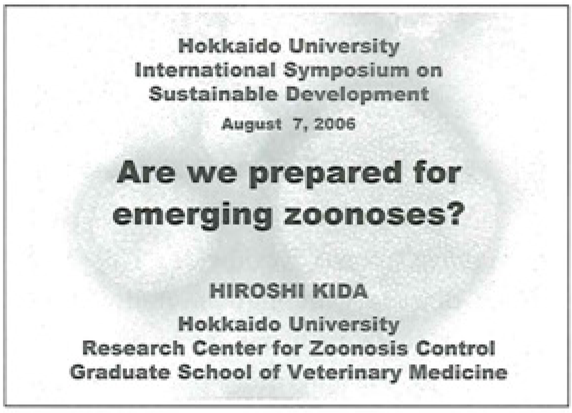
Hiroshi Kida

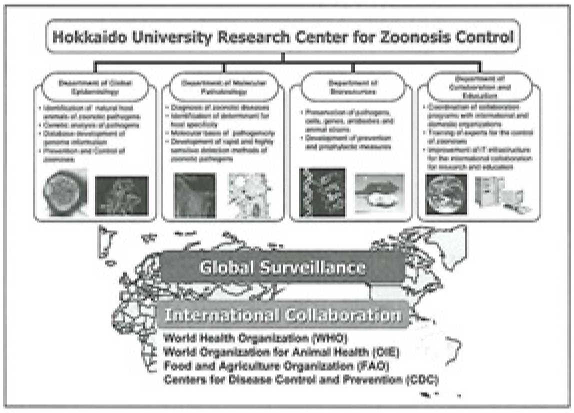
Director, Research Center for Zoonosis Control
Professor, Graduate School of Veterinary Medicine
Hokkaido University
E-mail: kida@vetmed.hokudai.ac.jp

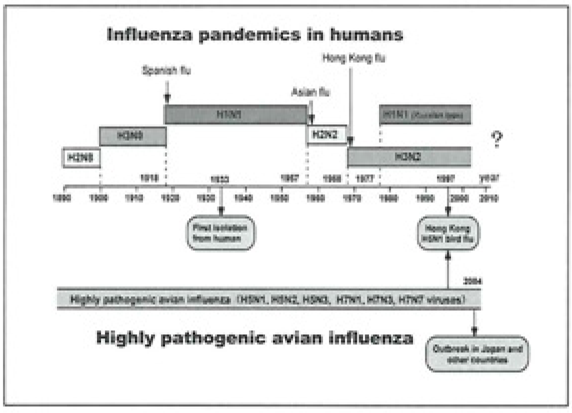
Recent outbreaks of highly pathogenic avian influenza have spread worldwide. This H5N1 virus has jumped the species barrier and caused severe disease with high mortality in humans. A concern is that only the H5N1 virus is assumed to cause next pandemic in humans. Since each of the subtypes of influenza 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.

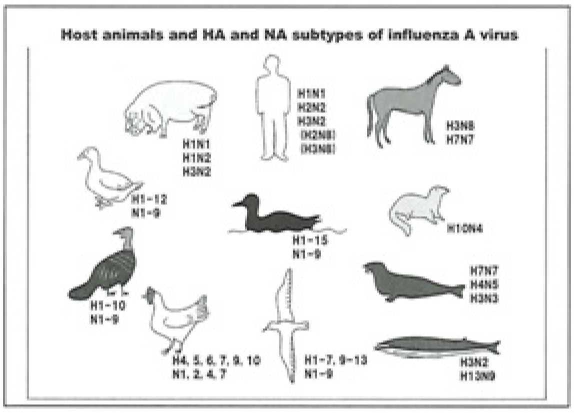
We have carried out global surveillance study of avian influenza and influenza virus isolates of 49 combinations of HA and NA subtypes have been isolated from fecal samples of ducks. So far, 76 other combinations have been generated by the genetic reassortment procedure in chicken embryos. Thus, avian 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.

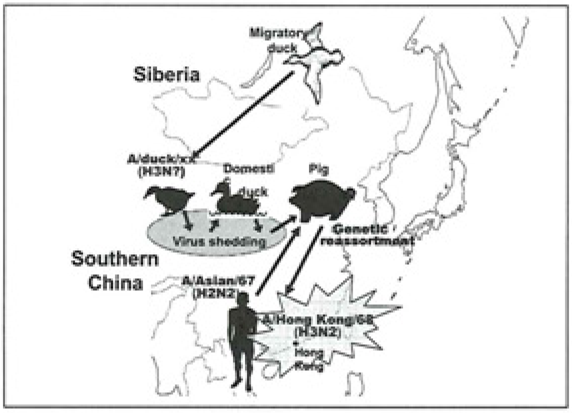
On the basis of the strategy for the control of influenza, Hokkaido University has established "Research Center for Zoonosis Control" in 2005. The long term goals of the center are the prevention and control of emerging zoonoses. To achieve the goals, the aims of the present program are; 1) to elucidate 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 pathogenisity 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.

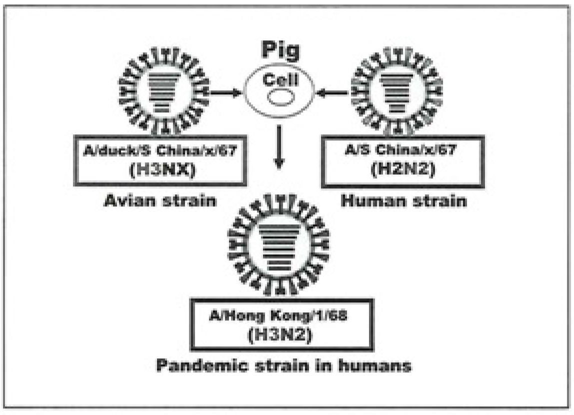












The role of pigs in the emergence of pandemic strains

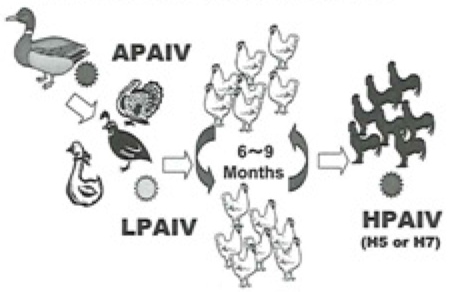
- Pigs are susceptible to avian influenza viruses of each of the HA subtypes.
- Genetic reassortants were generated in the cells lining upper respiratory tract of pig upon concurrent infection with mammalian and avian strains.

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 ($logEID_{50}/g$)							
	Trachea	Lungs	Intestine	Kidney	Spleen	[illegible]	Muscle	Blood
Duck/Hok/9/99 (H9N2)	–	–	–	–	–	–	–	–
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 sequences
H1	Dk/Alberta/35/76(H1N1)[b]	IQSR GLF
H2	Mal/MT/Y61(H2N2)[b]	IESR GLF
H3	Dk/Menphis/928/74(H3N8)[b]	KQTR GLF
H4	Dk/Czechoslovakia/56(H4N6)[b]	KASR GLF
H5	**Ck/Scotland/59(H5N1)[b]**	**RKKR GLF**
H5	Ty/MN/3/92(H5N2)[a]	RETR GLF
H6	Shw/Australia/1/72(H6N5)[b]	IETR GLF
H7	**FPV/Rostock/34(H7N1)[b]**	**KKRKKR GLF**
H7	Mal/Alberta/195/89(H7N3)[a]	KKTR GLF
H8	Ty/Ontario/6118/68(H8N4)[b]	VEPR GLF
H9	Ty/Wisconsin/66(H9N2)[b]	RSSR GLF
H10	Ck/Germany/N/49(H10N7)[b]	VQGR GLF
H11	Dk/England/56(H11N6)[b]	IASR GLF
H12	Dk/Alberta/60/76(H12N5)[b]	VQDR GLF
H13	Gl/Maryland/704/77(H13N6)[b]	ISNR GLF
H14	Mal/Gurjev/263/82(H14N5)[b]	KQAK GLF
H15	Shw/Australia/2576/79(H15N9)[b]	IRTR GLF

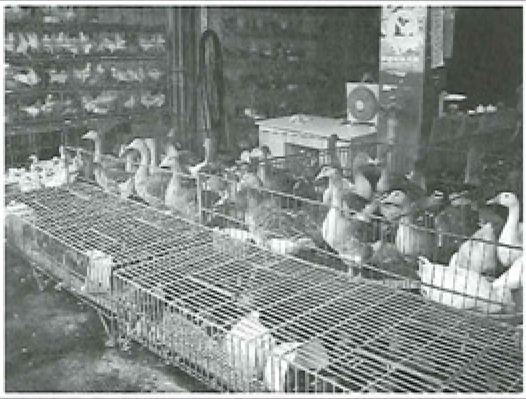
Senne et al, 1996[a], Kovacova et al, 2002[b]

Pathogenicity of influenza virus for chicken

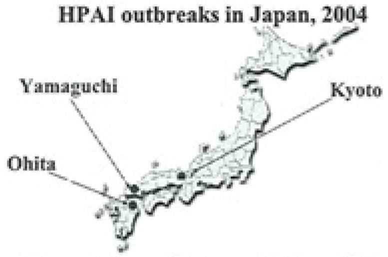
Cleavability of the HA protein into HA1 and HA2 is crucial and consecutive alignment of basic amino acids (R, K) at the cleavage site is related to the pathogenicity for chicken.

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

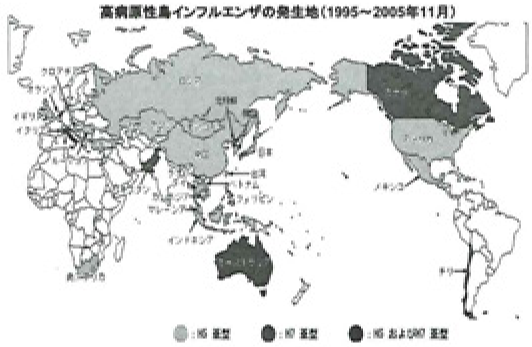
→ penetration by fusion into host cell
→ extensive replication → systemic infection

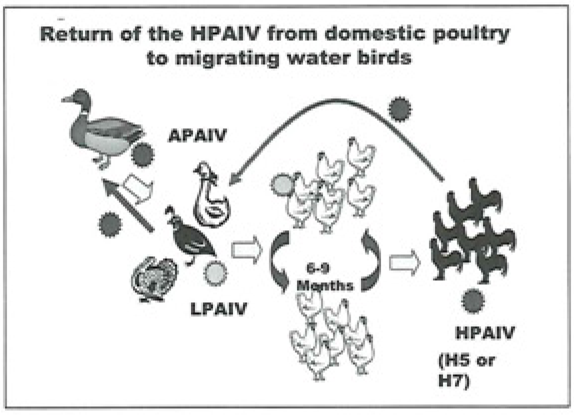


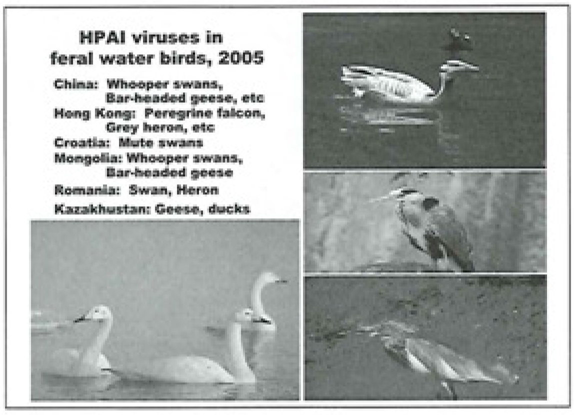
HPAI outbreaks in Japan, 2004

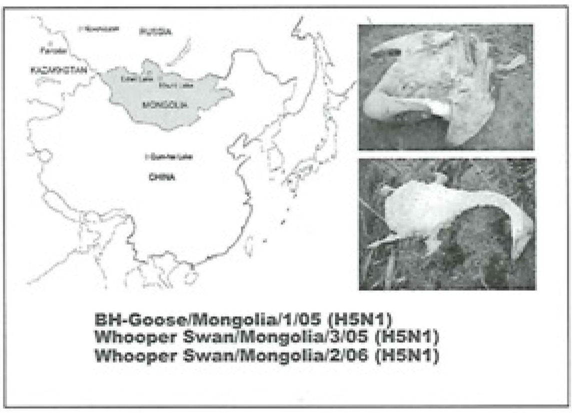


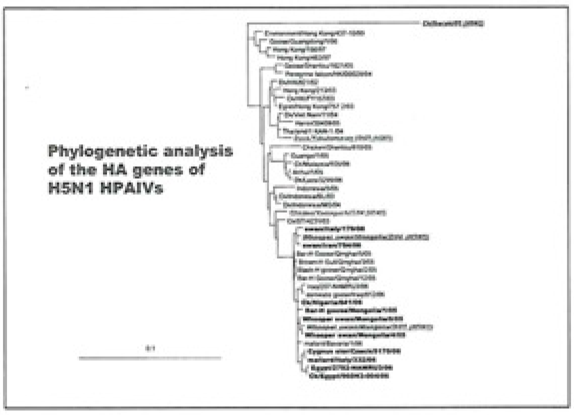
1	Yamaguchi Pref.	1/12/04	34,000 layers	H5N1	HPAI
2	Oita Pref.	2/17/04	13 pet cks	H5N1	HPAI
3	Kyoto Pref.	2/28/04	225,325 layers	H5N1	HPAI
4	Kyoto Pref.	3/ 5/04	15,000 broilers	H5N1	HPAI

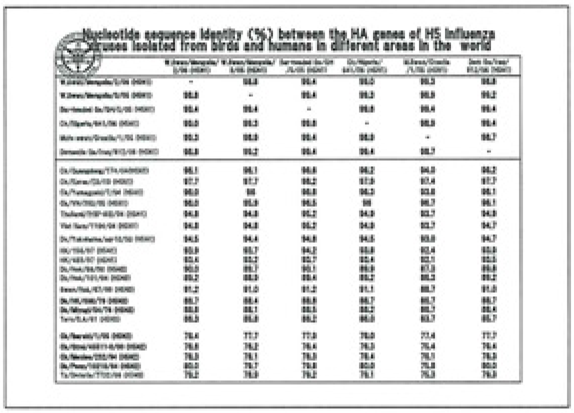


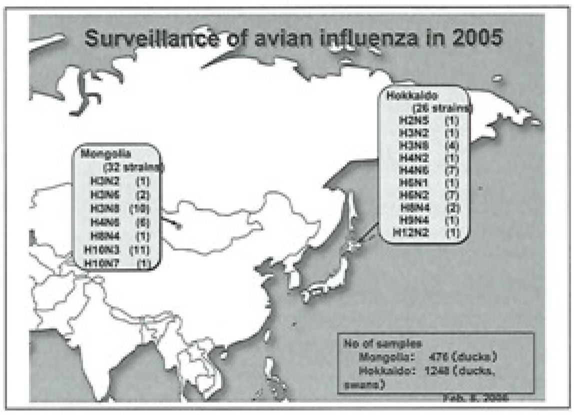

Return of the HPAIV from domestic poultry to migrating water birds
APAIV
6-9 Months
LPAIV
HPAIV
(H5 or H7)

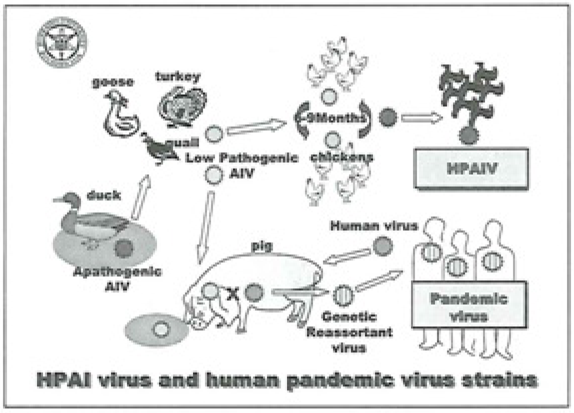

HPAI viruses in feral water birds, 2005
China: Whooper swans, Bar-headed geese, etc
Hong Kong: Peregrine falcon, Grey heron, etc
Croatia: Mute swans
Mongolia: Whooper swans, Bar-headed geese
Romania: Swan, Heron
Kazakhustan: Geese, ducks

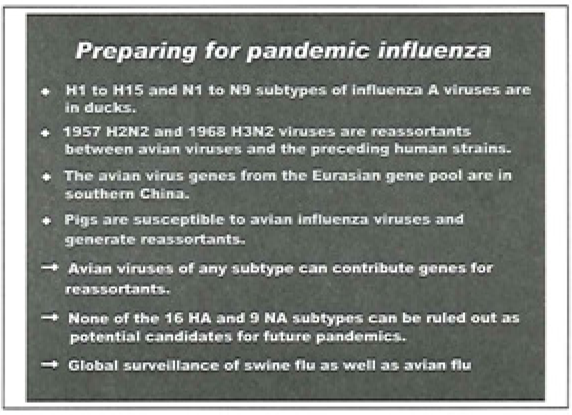

RUSSIA
KAZAKHSTAN
MONGOLIA
CHINA
BH-Goose/Mongolia/1/05 (H5N1)
Whooper Swan/Mongolia/3/05 (H5N1)
Whooper Swan/Mongolia/2/06 (H5N1)


Phylogenetic analysis of the HA genes of H5N1 HPAIVs

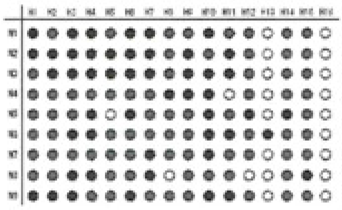

Nucleotide sequence identity (%) between the HA genes of H5 influenza viruses isolated from birds and humans in different areas in the world


Surveillance of avian influenza in 2005
Hokkaido (26 strains)
H2N5 (1)
H3N2 (1)
H3N8 (4)
H4N2 (1)
H4N6 (7)
H5N1 (1)
H6N2 (7)
H8N4 (2)
H9N4 (1)
H12N2 (1)
Mongolia (32 strains)
H3N2 (1)
H3N6 (2)
H3N8 (10)
H4N6 (6)
H8N4 (1)
H10N3 (11)
H10N7 (1)
No of samples
Mongolia: 476 (ducks)
Hokkaido: 1248 (ducks, swans)
Feb. 8, 2006


goose
turkey
quail
Low Pathogenic AIV
6-9Months
chickens
HPAIV
duck
Apathogenic AIV
pig
Human virus
Genetic Reassortant virus
Pandemic virus
HPAI virus and human pandemic virus strains


Preparing for pandemic influenza
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).

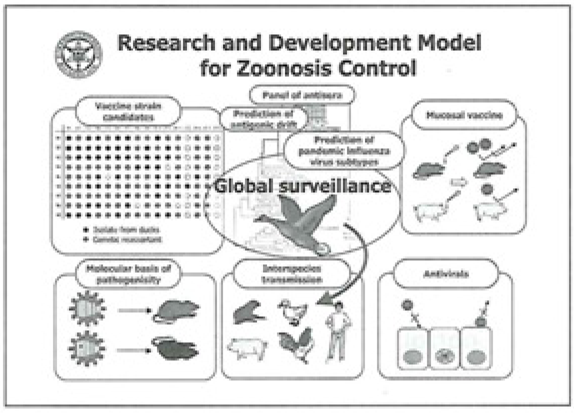
Thus, avian influenza viruses of 123 combinations of HA and NA subtypes have been stocked as vaccine strain candidates. Their pathogenicity, antigenicity, genetic information and yield in chicken embryo have been analyzed, and being databased.

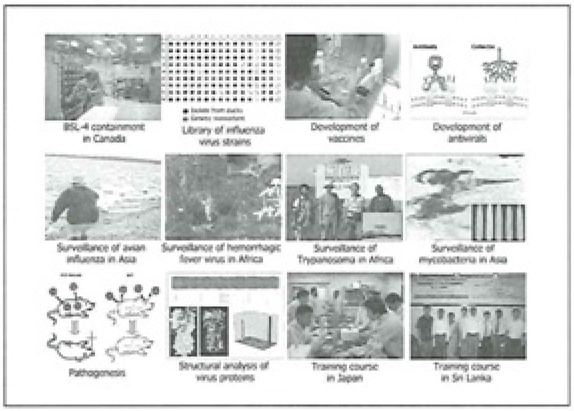
Program of Founding Research Centers for Emerging and Reemerging Infectious Diseases

Research and Education for Zoonosis Control

Hokkaido University Research Center for Zoonosis Control

Hiroshi Kida
Principal Investigator

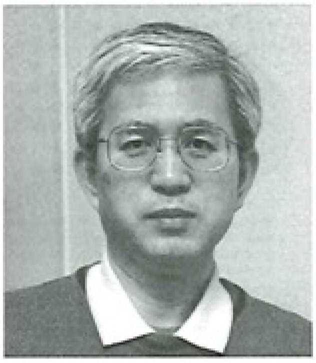




Points of Discussion

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.

Hokkaido University International Symposium on Sustainable Development
Plenary Session 4: Monday August 7, 2006 / 4:20pm-4:50pm

Speaker

Understanding and Approach to "Sustainability" Science of Fisheries

Teisuke Miura

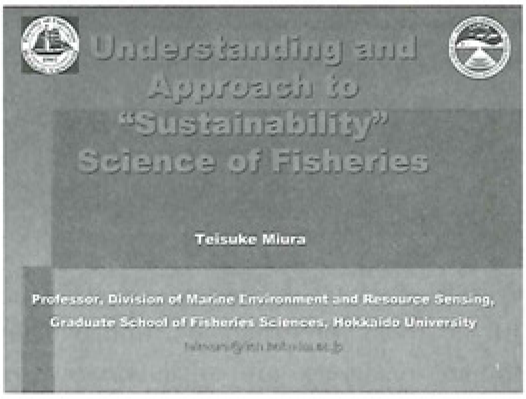
Professor
Division of Marine Environment and Resource Sensing
Graduate School of Fisheries Sciences
Hokkaido University
E-mail: teimiura@fish.hokudai.ac.jp

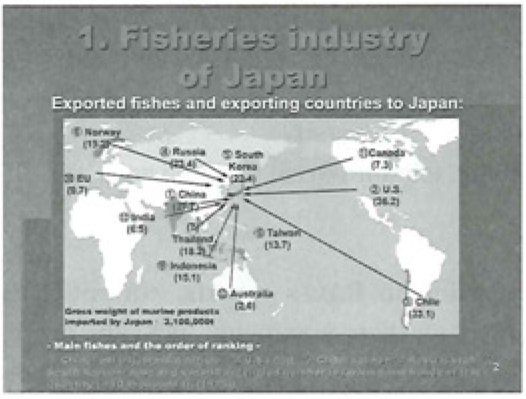
According to FAO's reports, currently, approximately 44% of key fish species are being exploited at their maximum, 16% are overexploited with no room for expansion, and 6% have been depleted. These figures show that world's aquatic resources are unsustainably, not sustainably, used. Japan imports approximately 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.

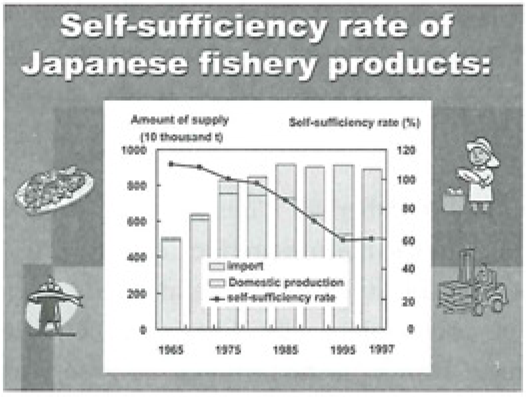
In these circumstances, how should we consider sustainable fisheries? Considerations that we need to make in considering global sustainability of Japan's marine-product supply are: ① the establishment of global supply system; ②the securing of stable supply and safety of imported fishery products; and ③the 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.

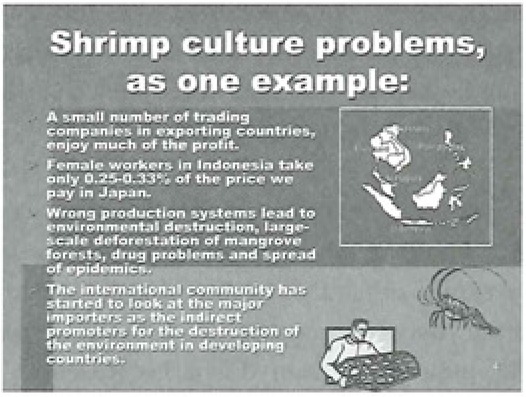
However, there is currently no clear definition of "sustainability of the fisheries industry." In this paper, I attempt to establish it logically. There are various ways to interpret the word "sustainability." Japan for Sustainability (JFS), for example, considers sustainability as from five basic compositions: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

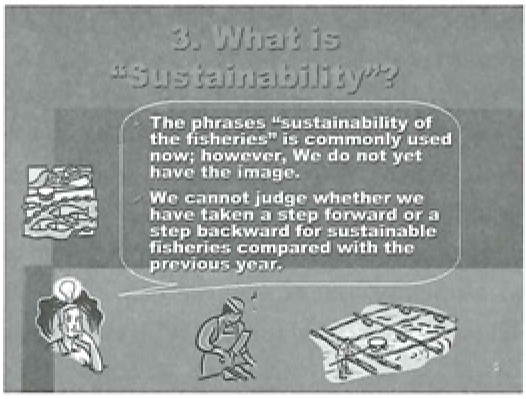
Based on this JFS's concept, the author fist discuses sustainability of the fisheries industry and then examines the "sustainability" science of fisheries-theme of this lecture-more specifically, ①new logic of the "sustainability" science of fisheries, ②educational philosophy of the "sustainability"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

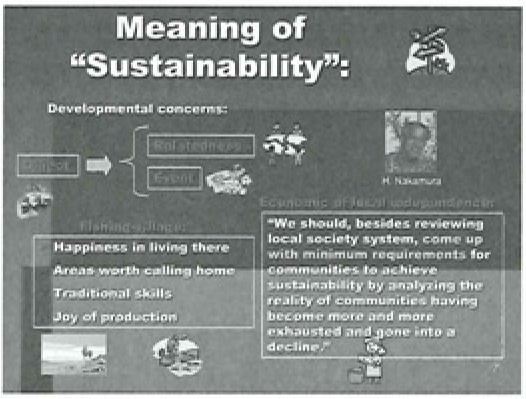










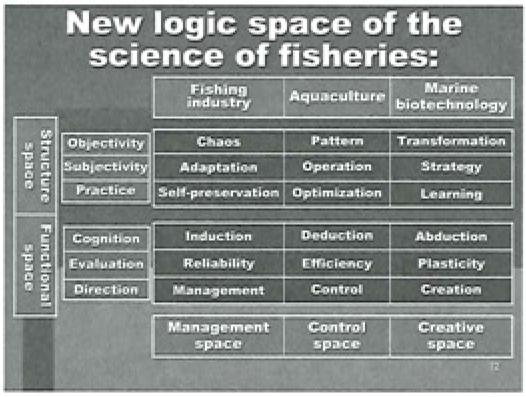

Meaning of "Sustainability":
Developmental concerns:
Relatedness
Event
H. Nakamura
Happiness in living there
Areas worth calling home
Traditional skills
Joy of production
"We should, besides reviewing local society system, come up with minimum requirements for communities to achieve sustainability by analyzing the reality of communities having become more and more exhausted and gone into a decline."

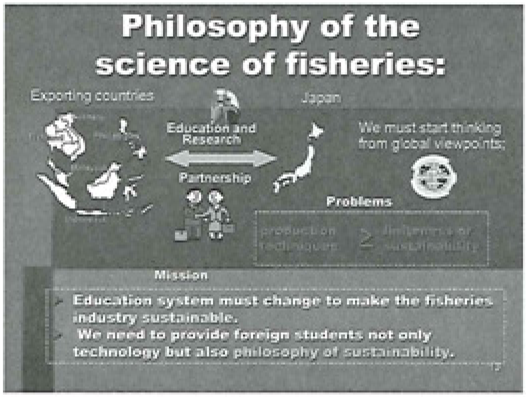

Seven items in relation to "Multifunctionality":
Conservation of the natural environment and ecosystems;
Securing the safety of the people;
Preservation and creation of sound landscapes;
Provision of places for leisure activities to the people;
Passing-on of traditional cultures;
Maintenance of local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


Five basic compositions of JFS's "Sustainability":
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)";
To receive the inheritance of previous generation and pass it on to future generation correctly;
To distribute wealth, goods and resources between nations and regions in an equitable way, and there is no exploitation from one to another;
To respect the diversity of individuals, species, culture, which is also of other organisms; and
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":
Natural, global and local environments including the concepts of resource capacity and biodiversity. A fundamental concept of sustainability;
Something which enriches human life and makes the life easier by providing goods and services. An economic activity in general;
Social activity, government, school, community, etc. An aggregation of human life; and
Individual's self-actualization, pursuit of happiness, social participation, and improvement of quality-of-life.
10


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
Subjectivity
Practice
Chaos
Pattern
Transformation
Adaptation
Operation
Strategy
Self-preservation
Optimization
Learning
Functional space
Cognition
Evaluation
Direction
Induction
Deduction
Abduction
Reliability
Efficiency
Plasticity
Management
Control
Creation
Management space
Control space
Creative space
12


Philosophy of the science of fisheries:
Exporting countries
Japan
Education and Research
Partnership
We must start thinking from global viewpoints;
Problems
Mission
Education system must change to make the fisheries industry sustainable.
We need to provide foreign students not only technology but also philosophy of sustainability.


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 inconstancy 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."

Confucianism

Gojo-no-toku (five ethics)

- Jin (Humaneness)
- Gi (Rightness)
- Rei (Ritual decorum)
- Chi (Wisdom)
- Shin (Trustworthiness)

In Bushido (samurai code), Gi (Rightness) was considered most important.

This is because Gi, right ways of living as a human, is more difficult than others to attain.

- This is an all-time sense of values.
- We, as those living in modern age, should ask ourselves anew the meaning of it.
- I thinks that basis of all future educational, research and socioeconomic activities should have 義 (Rightness) in them.
- With the emotional pillar, I will approach to specific individual problems.

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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.

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"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.

Kiyoshi Kurokawa

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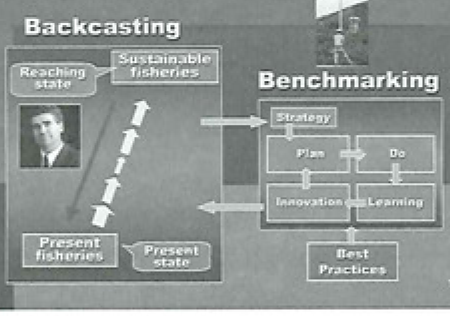
Fisheries subjects which we have to consider:

- 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?

18

7. Framework for practice:



19

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.

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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)
E-mail: ifeed@t-online.de

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.

(IR3S), Sappro,Hokkaido Universty, 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:

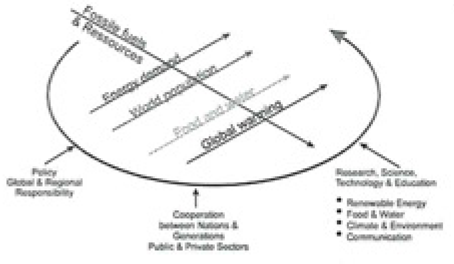
"resource-conserving,

socially supportive,

commercially competitive,

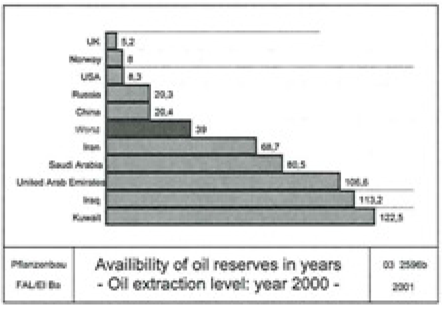
and environmentally sound"

Basic Reasons for unsustainable Development

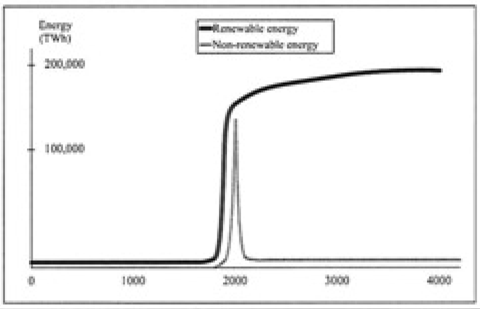


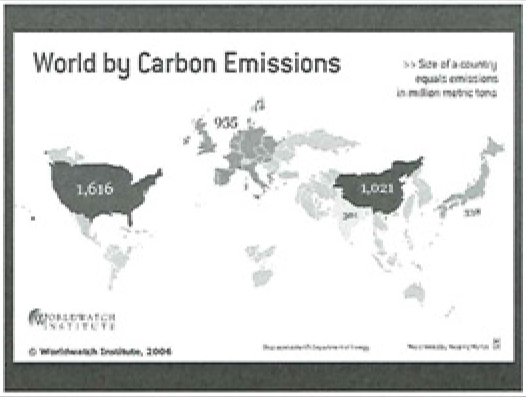
Energy, Environment and Development

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





Environmental Performance Index (EPI)
Overall EPI scores(0-100)

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

Rank	Country	Score
1	New Zealand	88.0
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 Rodeo wildfire Saturday, June 22, 2002, in Show Low, Ariz. Rodeo and the Chedeski 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 polices could lead the increasing conflicts over scares resources (energy, water and food)

Poverty is rural

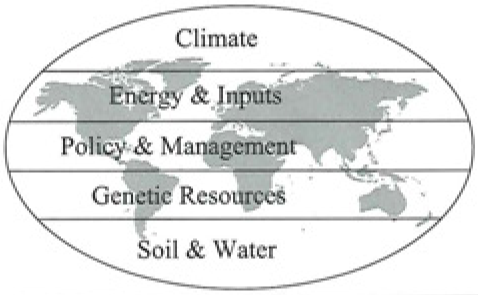
- 2.8 billions of employees earn less than 2 US$ per day
- 1,4 billions of the employees earn less than 1 US$ per day
- Only 300 persons possess more than 3 billions of the world population
- Most of poor peoples are living in rural regions

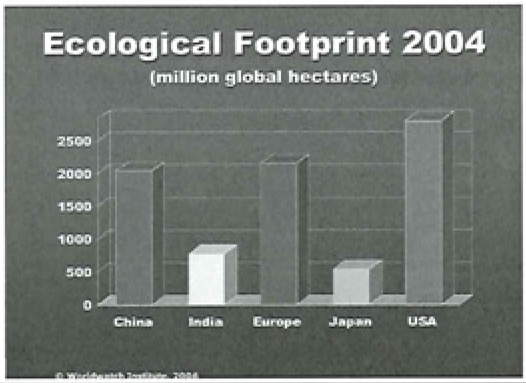
(Davos 2006)

World `s poorest people suffer the most because:

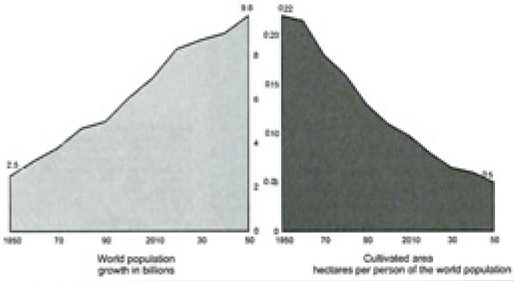
- Their narrow margin of survival
- Lack of access to technologies
- Vulnerability to natural hazards and
- Fragility of the ecosystems in which they are concentrated

Fundamentals of sustainability in agriculture

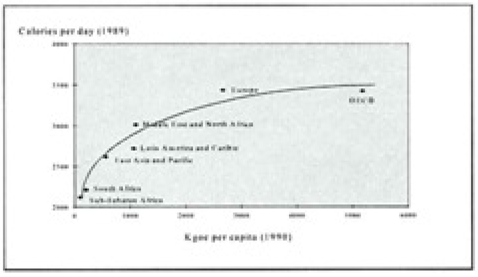




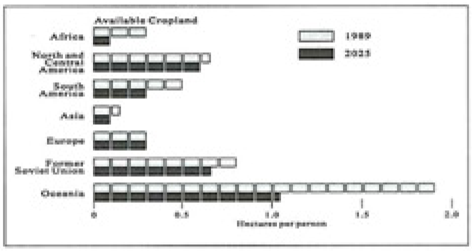
World population growth and respective per capita cultivated area from 1950-2050 (source: Future, 1998).



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)

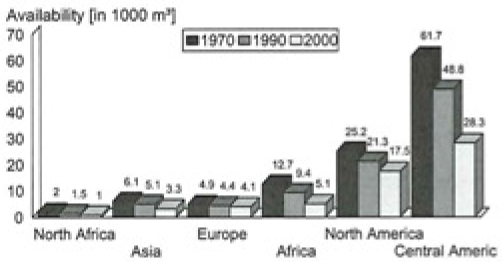


Global Water Availability

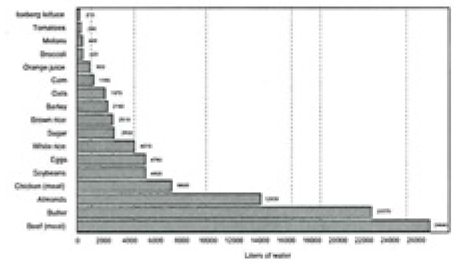
1) Approximately 3% of the world water resources are freshwater. Only 0,69% is available for human needs

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

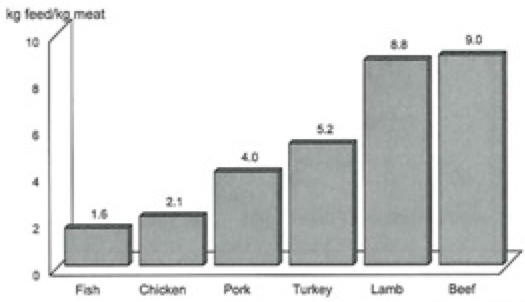
Water availability p.p. in selected areas in the years 1970, 1990 and estimated for 2000 (source: FAO).



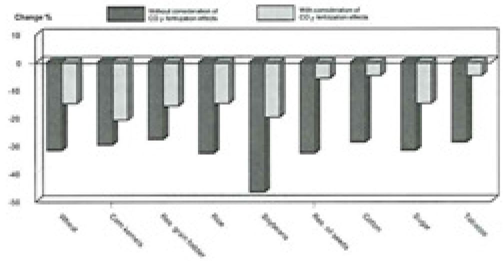
The amount of water in liters necessary to produce one kilogram of food (Water Education Foundation)



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



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

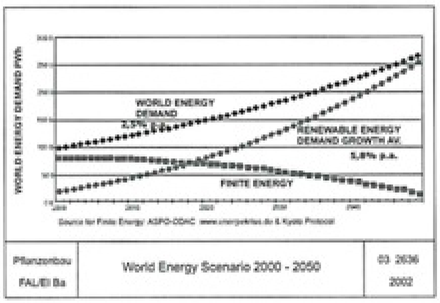


Global Biomass for Food, Energy and Energy & Perspectives

- ***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 Nepal, 45% in India, 28% in China and Brazil with conversion efficiency of less than 10%. The potential of improving this effiency 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 biomas producing areas (> 200 millions ha).***

- ***Microalgae have the potential to achieve a greater level of photosynthetic effiency 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 photosythetic is less than 1%. An increase in this efficiency (through genetic engineering) would have spectacular effects in biomass productivity: successful transformation of C_4-mechanism (from maize) to C_3-crops (rice). New achievement in accelarating 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.***



The Solution:

System Integration

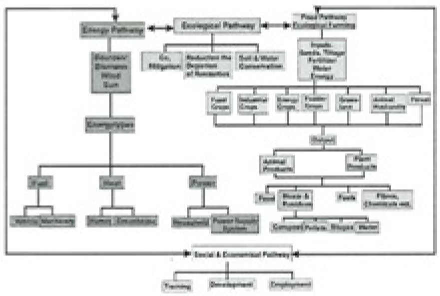
United Nations FAO-SREN Strategy towards Achievment of Susainable Development

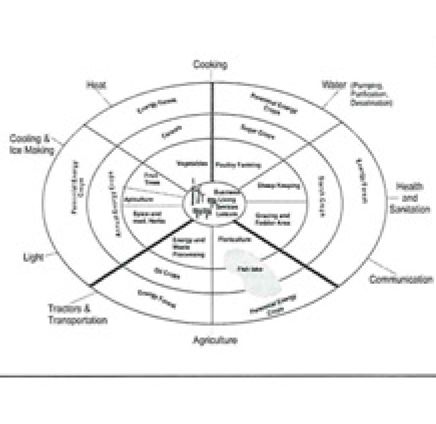
The Concept of the Integrated Energy Communities (IEC)

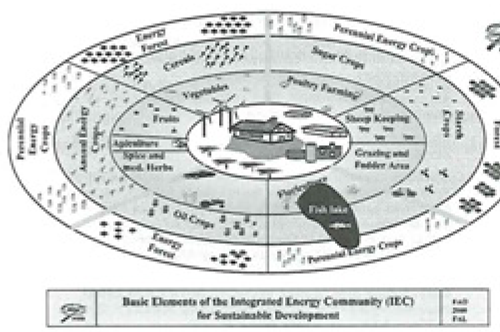
The Concept of Integrated Energy Farms and Communities (IEF)

- Farming system with optimal energetic, water and food autonomy with export possibilities
- Combination of different possibilities of non-polluting renewable energy sources i.e. biomass, wind, micro-hydro and solar for electricity and heat generation.
- The IEF concept is especially qualified for decentralised living areas and islands
- Integrated Energy Farms comprise of compartments for growing food crops, vegetable, fruit trees, annual and perennial energy crops and short rotation forests, along with wind and solar energy units
- The concept should comprise various models for different climatic zones and regions

Pathways of the Integrated Energy Communities for Sustainable Development







Basic Elements of the Integrated Energy Community (IEC) for Sustainable Development

Climate Region	Energy source	Power production (% of total need)	Heat production (% of total need)	Biomass need (t/ha)*	Biomass area (% of total area)
North and Central Europe	Solar	7	15		
	Wind	100	-		
	Biomass	100	105	60	12
South Europe	Solar	12,7	40		
	Wind	100	-		
	Biomass	70	45	36	4,8
North Africa Sahara	Solar	21	90		
	Wind	75	-		
	Biomass	25	25	14	1,2
Equatorial region	Solar	18,2	25,5		
	Wind	45	-		
	Biomass	70	80	45	10

Possible Share of Renewable Energy Sources in Various Climatic Zones
- Farm Activities -

Pflanzenbau FAL/El Ba 2001

Biomass for Food, Energy and the Environment

- Aleman Grass (*Echinochloa polystachya*)
- Babassu palm (*Orbignya oleifera*)
- Bamboo (*Bambusa spp.*)
- Banana (*Musa x paradisiaca*)
- Black locust (*Robinia pseudoacacia*)
- Brown beetle gras (*Leptochloa fusca*)
- Cassava (*Manihot esculenta*)
- Castor oil plant (*Ricinus communis*)
- Coconut palm (*Cocos nucifera*)
- Eucalyptus (*Eucalyptus spp.*)
- Jatropha (*Jatropha curcas.*)
- Jute (*Crocorus spp.*)
- Leucaena (*Leucaena leucocephala*)
- Neem tree (*Azadirachta indica*)
- Oil palm (*Elaeis guineensis*)
- Papaya (*Carica papaya.*)
- Rubber tree (*Acacia senegal*)
- Sisal (*Agave sisalana*)
- Sorghum (*Sorghum bicolor*)
- Soybean (*Glycine max*)
- *Sugar cane (Saccharum officinarum)*

Representative Energy Plant Species for different climate regions
- Tropical and Subtropical Climate -

Pflanzenbau FAL/El Ba 2000

- Argan tree (*Argania spinosa*)
- Broom (Ginestra) (*Spartium junceum*)
- Cardoon (*Cynara cardunculus*)
- Date palm (*Phoenix dactylifera*)
- Eucalyptus (*Eucalyptus spp.*)
- Giant reed (*Arundo donax*)
- Groundnut (*Arachis hypogaea*)
- Jojoba (*Simmondsia chinensis*)
- Olive (Olea europaea.)
- Poplar (*Populus spp.*)
- Rape (*Brassica napus*)
- Safflower (*Carthamus tinctorius*)
- Salicornia (*Salicornia bigelovii*)
- Sesbania (*Sesbania spp.*)
- Soybean (*Glycine max*)
- Sweet sorghum (*Sorghum bicolor*)

Representative Energy Plant Species for different climate regions
- Aride and Semiaride Climate -

Pflanzenbau FAL/El Ba 2000

- Cordgrass (*Spartina spp.*)
- Fibre sorghum (*Sorghum bicolor*)
- Giant knotweed (*Polygonum sachalinensis*)
- Hemp (*Cannabis sativa*)
- Kenaf (*Hibiscus cannabinus*)
- Linseed (*Linum usitatissimum*)
- Miscanthus (*Miscanthus x giganteus*)
- Poplar (*Populus spp.*)
- Rape (*Brassica napus*)
- Reed Canary Grass (Phalaris arundinacea.)
- Rosin weed (*Silphium perfoliatum*)
- Safflower (*Carthamus tinctorius*)
- Soy bean (*Glycine max*)
- Sugar beet (*Beta vulgaris*)
- Sunflower (*Helianthus annuus*)
- Switchgrass (*Panicum virgatum*)
- Topinambur (*Helianthus tuberosus*)
- Willow (*Salix spp.*)

Representative Energy Plant Species for different climate regions
- Temperate Climate -

Pflanzenbau FAL/El Ba 2000

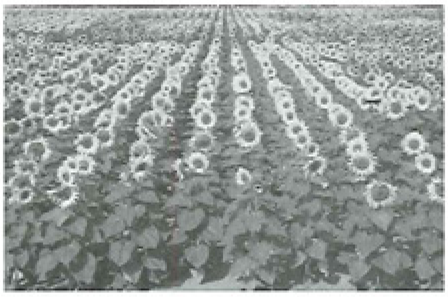
Tall Grasses

Miscanthus giganteus

Willows

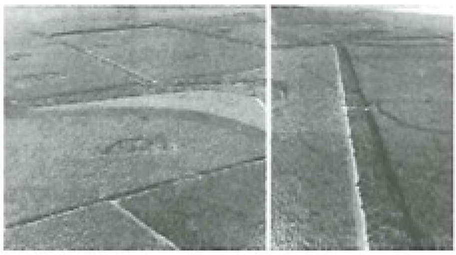
Arundo donax

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 -

→ Appropriat policy (Intention for Development)

→ Availibility

→ Accessbility

→ Acceptability

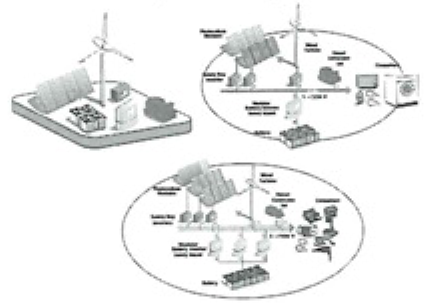
→ Affordability

Procedure of Energy Supply

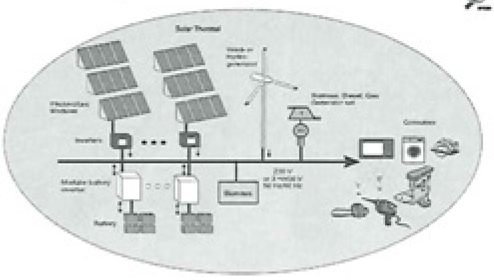
Needs Application → Renewable Energy Resources ↔ Technologies Systems Equipments

Renewable Energy Resources:
- •Solar
- •Wind
- •Biomass
- •Hydro (Microhydro Geothermal Waves)

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

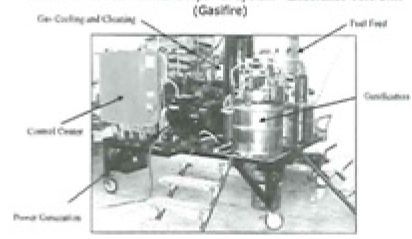


Renewable Energy Technologies - System Integration -



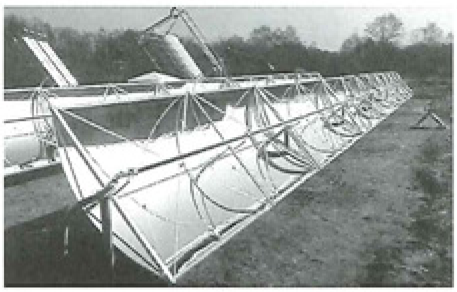
Mobile Power Generator (Solar, Wind, Bio-Diesel)

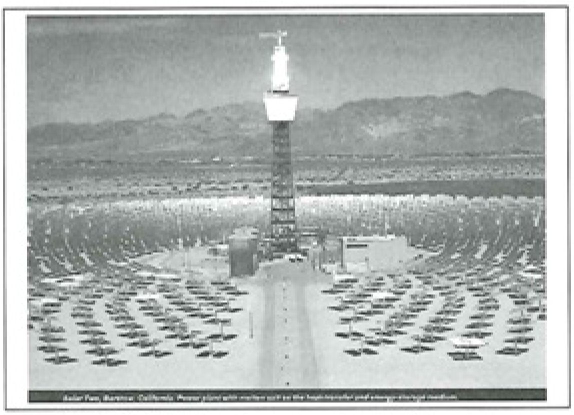
12 1/2 kW Small Modular Biopower System - Endurance Test Unit (Gasifire)

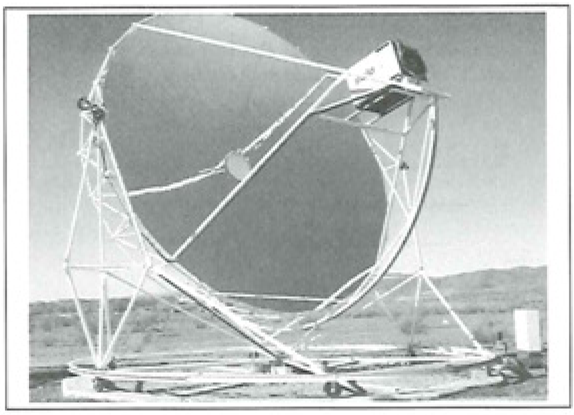


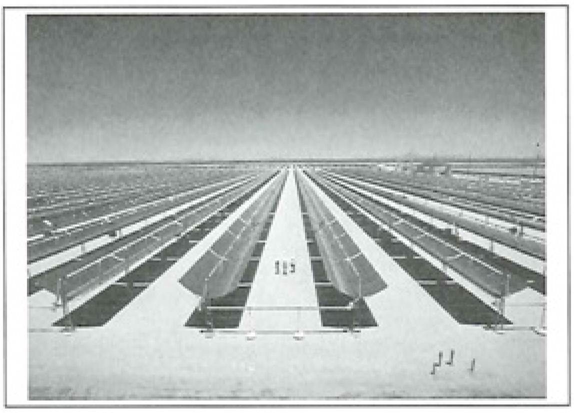
Micro Solar Thermal Power Generator

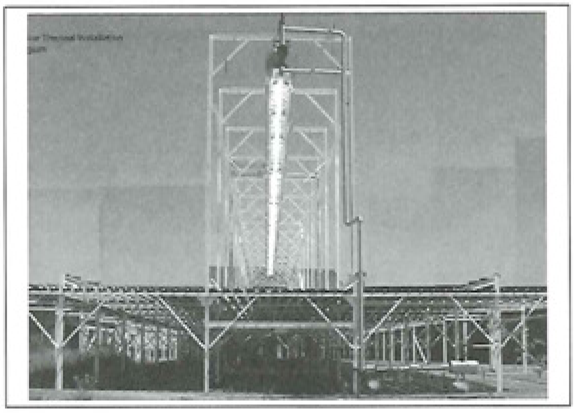
Solar Parabol Power Generator

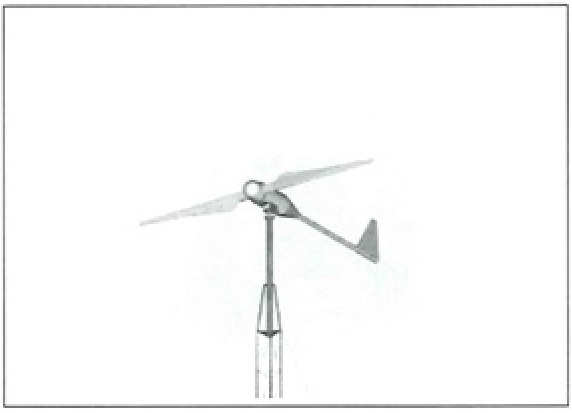




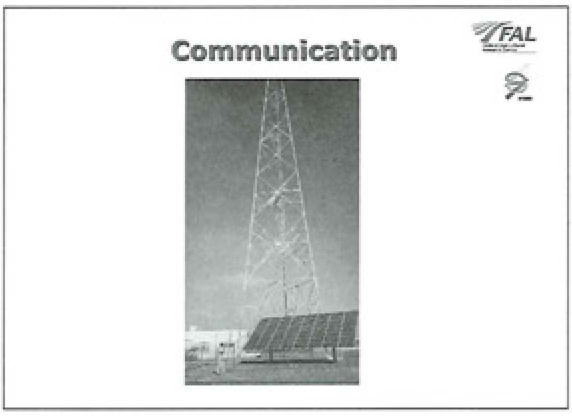


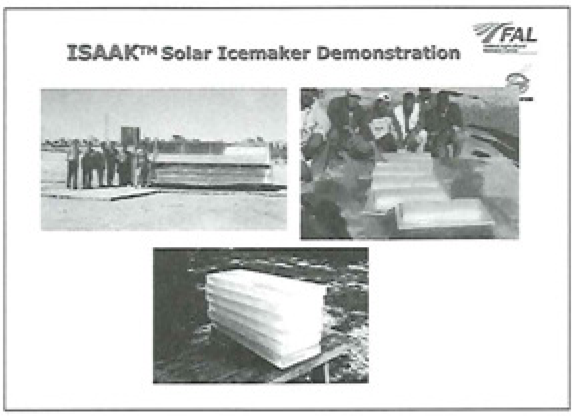


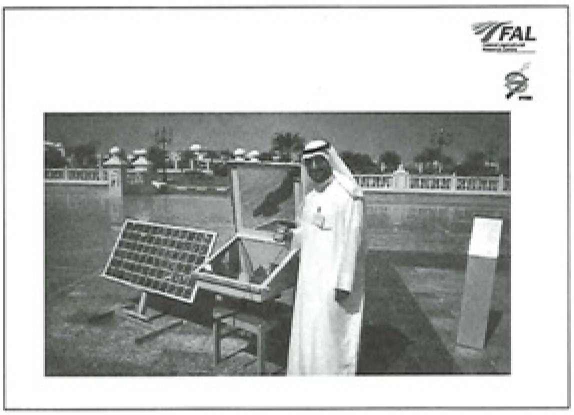




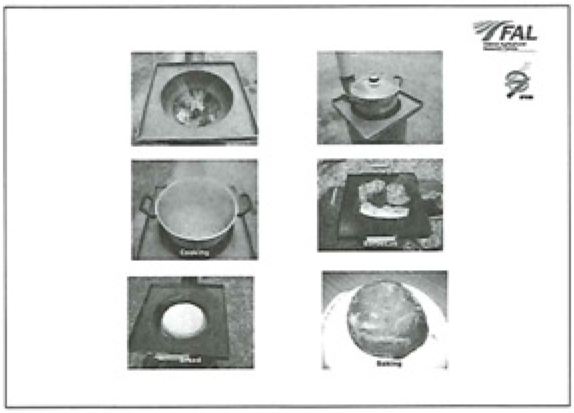

Solar Street Lantern
Solare Straßenbeleuchtung

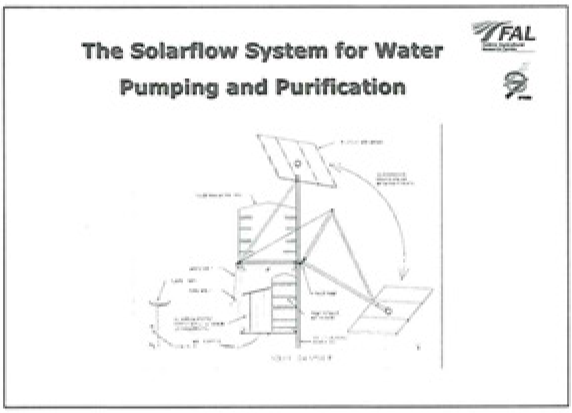

Communication
FAL

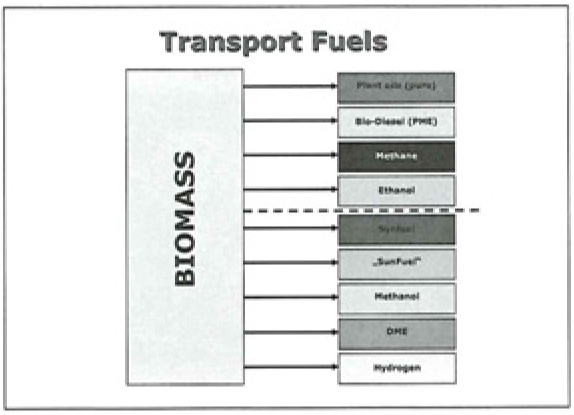

ISAAK™ Solar Icemaker Demonstration
FAL



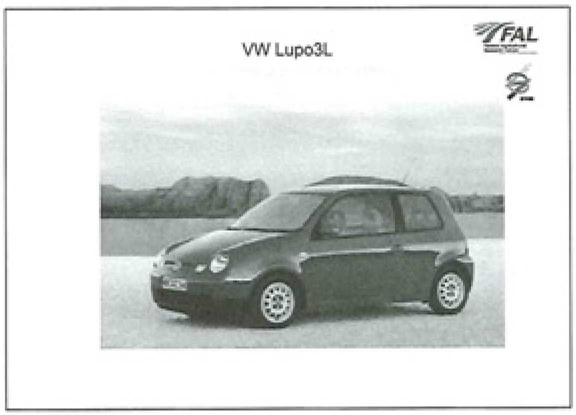

Biomass – Universal – Stove
Turbo-Stove BAFOB 5 KW
Multifunctional Stove for Cooking, Baking, Roasting, Barbecue and Heating


Cooking
Baking


The Solarflow System for Water Pumping and Purification

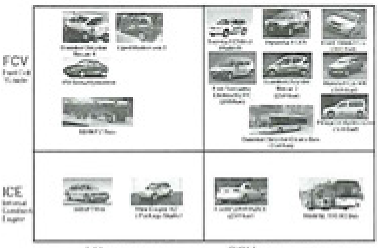

Transport Fuels
BIOMASS
Plant oils (pure)
Bio-Diesel (PME)
Methane
Ethanol
Synfuel
„SunFuel"
Methanol
DME
Hydrogen

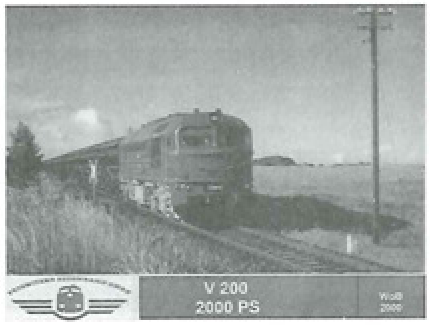

Ölfelder des 21. Jahrhunderts
-Oilfields of the 21st century-


VW Lupo3L

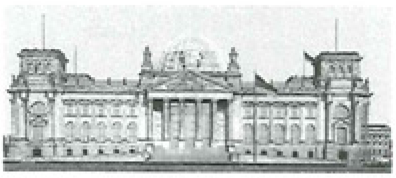
Recent Development in Alternative Fuel Vehicles

Wasserstoffaktivitäten Weltweit.
Aktuelle Aktivitäten der Automobilindustrie.





The German Parliament Berlin
Das Reichstagsgebäude in Berlin

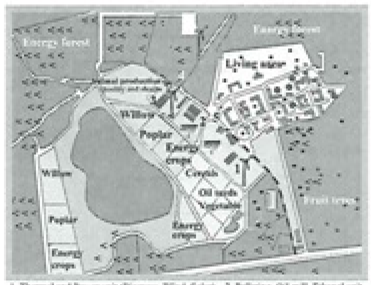


Energy Supply: 100% Biomass = 100% Renewable

Implementations

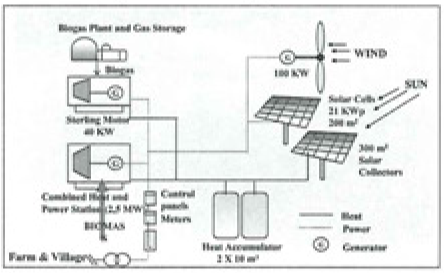
International Research Centre For Renewable Energy (IFEED) Dedelstorf, Germany (www.ifeed.org) & IEF (260 ha, 50 Buildings, 200 Persons)

Integrated Energy Farm located in Northern Germany



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

Combined Technologies for Heat and Power Production on Integrated Energy Farms



ITER – Renewable Energy Farm (Tenerife Island)

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 Spieces- Their Applications and Impact on Environment and Development. James&James Science Publishers, 1998*
- *Integrated Renewable Energy for Rural Communities- Plannining Guidlines, 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 Universty!

Thank you for your attention !

www.ifeed.org

E-mail: ifeed@t-online.de

Hokkaido University International Symposium on Sustainable Development
Plenary Session 4: Monday August 7, 2006 / 5:30pm-6:00pm
Speaker

The Sustainability of Bio-production Systems

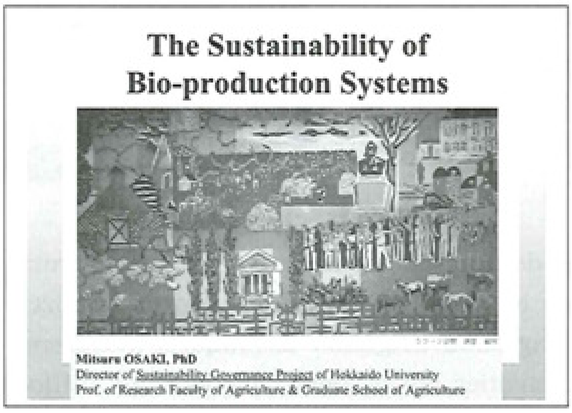
Mitsuru Osaki

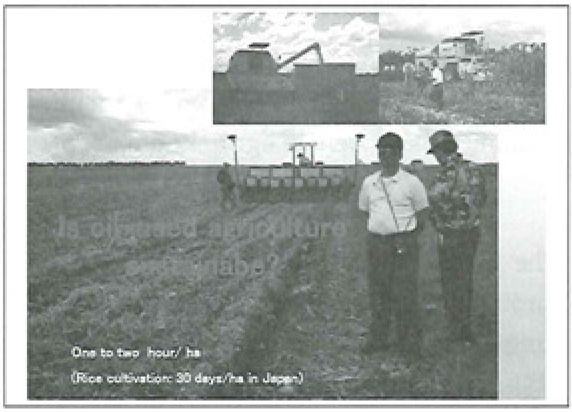
Director, Sustainability Governance Project, Hokkaido University
Professor, Research Faculty of Agriculture, Hokkaido University
E-mail: mosaki@chem.agr.hokudai.ac.jp

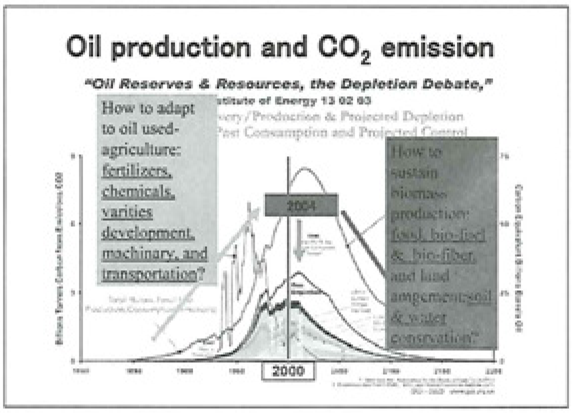
The present high productivity levels enjoyed by modern agronomy have largely been attained through intensive land management practices such as the vigorous application of fertilizers, fungicides, pesticides and herbicides, improved tillage and irrigation techniques, mono cropping, mechanization, and 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.

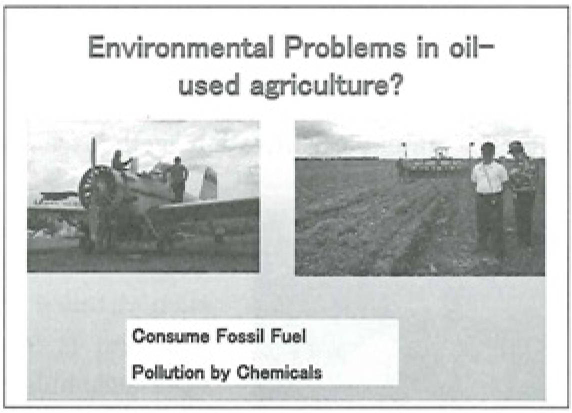
(a) Development of integrated and detailed models for sustainable biomass production: There are three compelling reasons why such detailed models are necessary for achieving sustainability. The first is to integrate the fragmented pieces of knowledge we have accumulated so far. The second is the process 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.

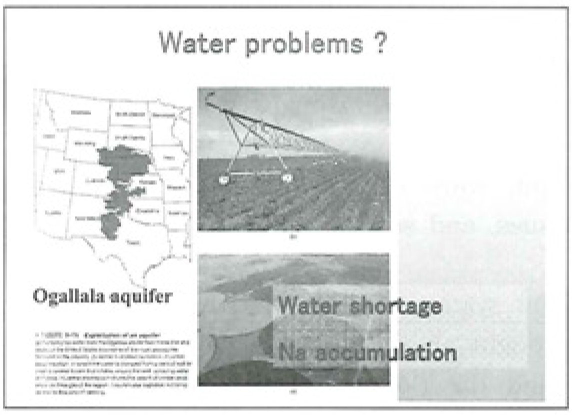
(b) Development of monitoring and risk management systems for food production fields: We are currently facing several important problems brought about by highly developed technology. Severe problems with residual chemicals and the flow of pesticides and chemical fertilizers exist in both agricultural and natural systems. For these reasons, we need to develop new monitoring systems and provide the governance to regulate them.

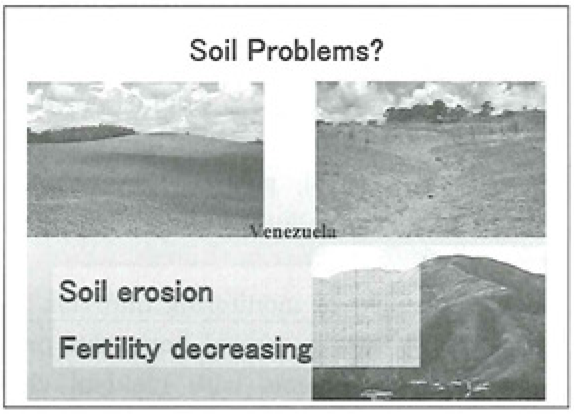


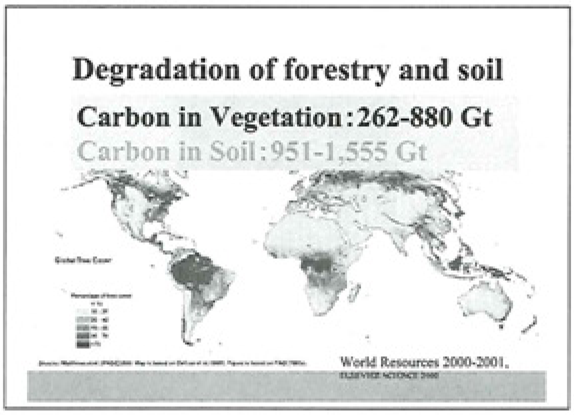




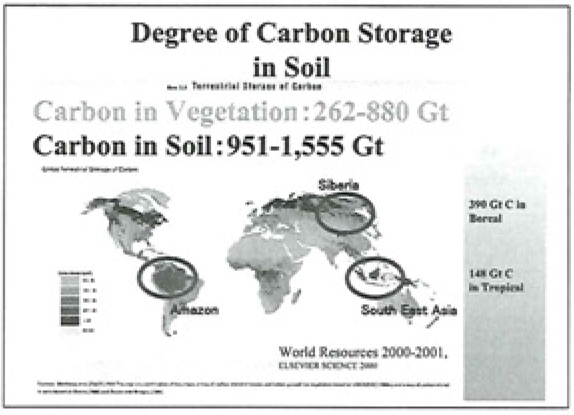




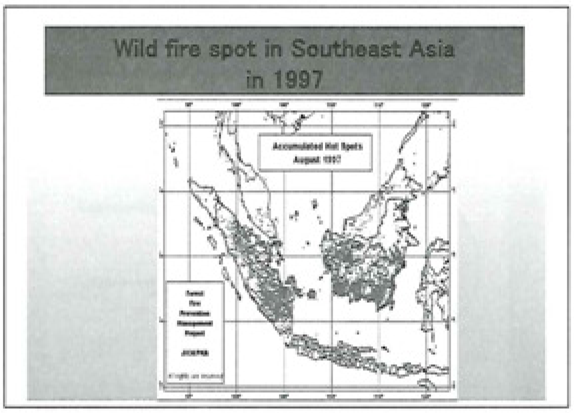




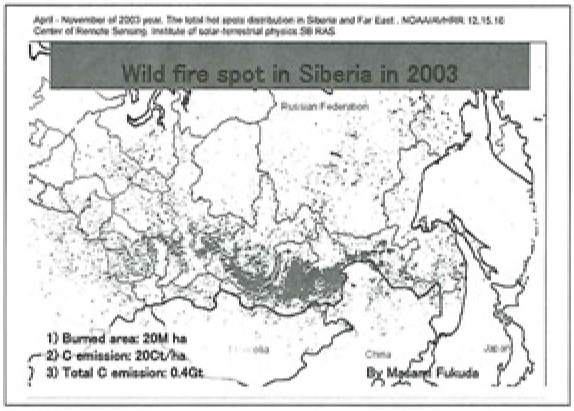
Degradation of forestry and soil
Carbon in Vegetation:262-880 Gt
Carbon in Soil:951-1,555 Gt
World Resources 2000-2001,



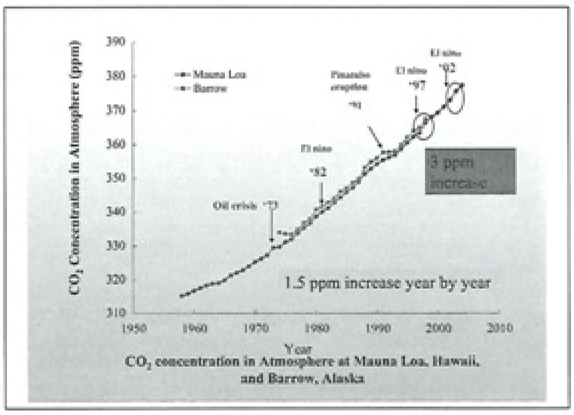
Degree of Carbon Storage in Soil
Carbon in Vegetation:262-880 Gt
Carbon in Soil:951-1,555 Gt
Siberia
Amazon
South East Asia
390 Gt C in Boreal
148 Gt C in Tropical
World Resources 2000-2001,



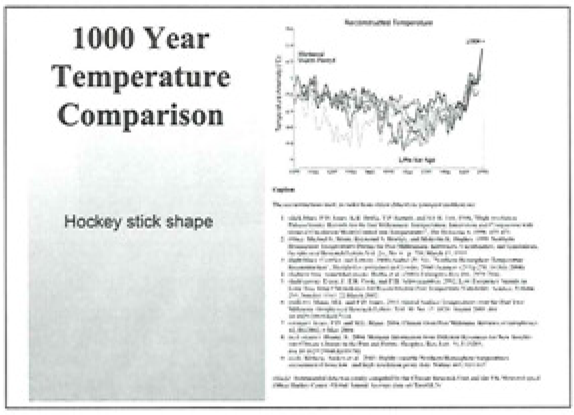
Wild fire spot in Southeast Asia in 1997
Accumulated Hot Spots August 1997



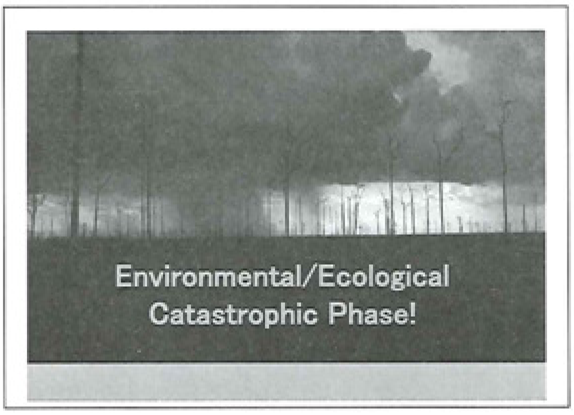
Wild fire spot in Siberia in 2003
Russian Federation
1) Burned area: 20M ha
2) C emission: 20Ct/ha
3) Total C emission: 0.4Gt
China
By Masami Fukuda



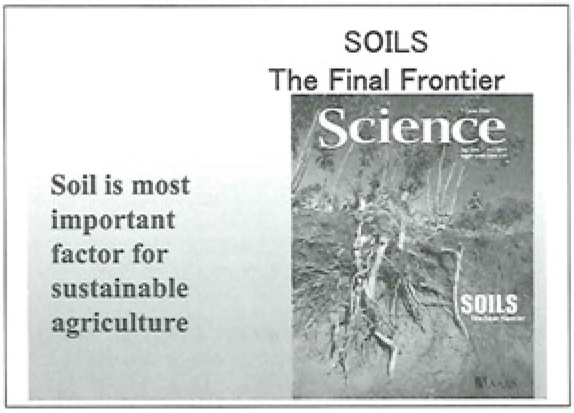
CO2 Concentration in Atmosphere (ppm)
Mauna Loa
Barrow
Oil crisis '73
El nino '82
Pinatubo eruption '91
El nino '97
El nino '02
3 ppm increase
1.5 ppm increase year by year
Year
CO2 concentration in Atmosphere at Mauna Loa, Hawaii, and Barrow, Alaska



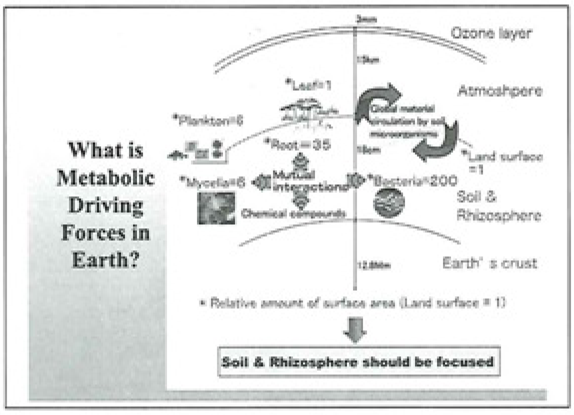
1000 Year Temperature Comparison
Hockey stick shape

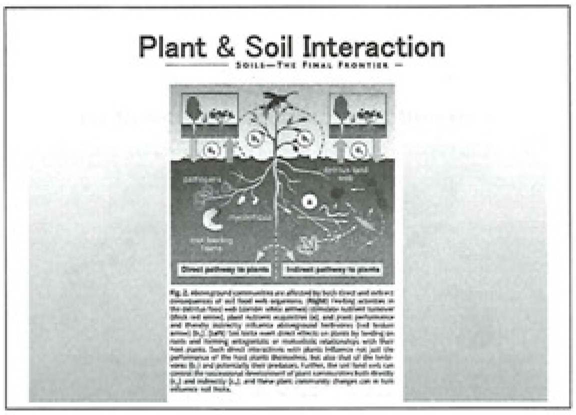


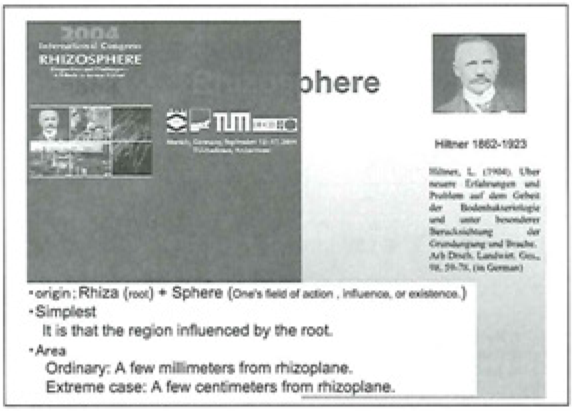
Environmental/Ecological Catastrophic Phase!

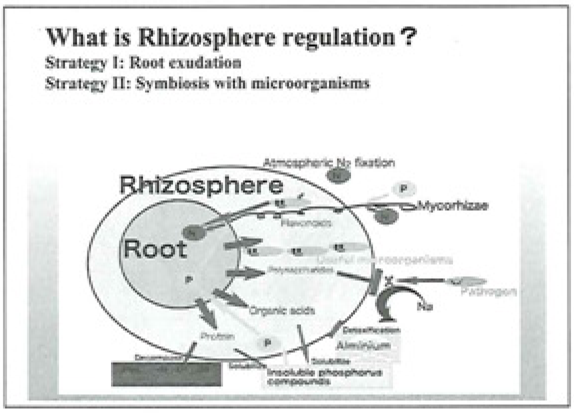


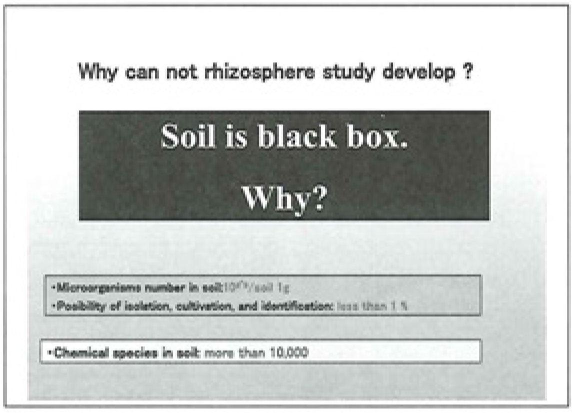
SOILS
The Final Frontier
Science
SOILS
Soil is most important factor for sustainable agriculture

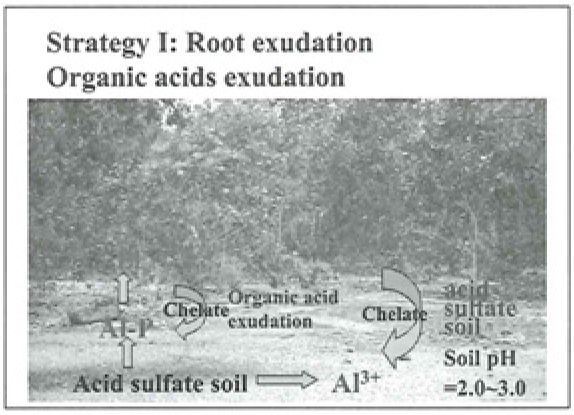

What is Metabolic Driving Forces in Earth?
Ozone layer
Atmoshpere
*Leaf=1
*Plankton=6
*Root=35
Global material circulation by soil microorganisms
*Land surface =1
*Mycelia=6
Mutual interactions
*Bacteria=200
Soil & Rhizosphere
Chemical compounds
Earth' s crust
* Relative amount of surface area (Land surface = 1)
Soil & Rhizosphere should be focused

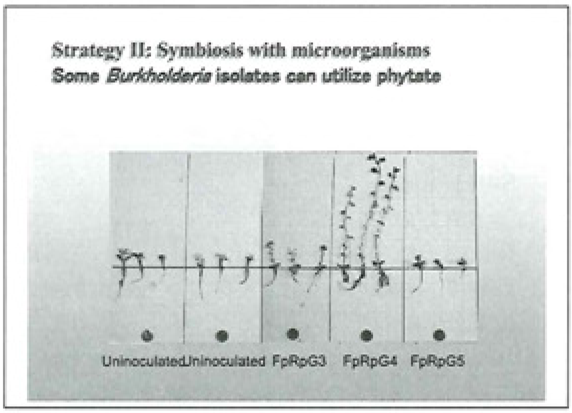

Plant & Soil Interaction
Direct pathway to plants
Indirect pathway to plants

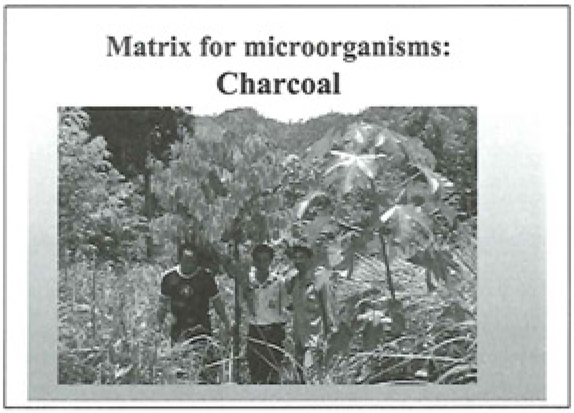

RHIZOSPHERE
phere
Hiltner 1862-1923
・origin: Rhiza (root) + Sphere (One's field of action , influence, or existence.)
・Simplest
It is that the region influenced by the root.
・Area
Ordinary: A few millimeters from rhizoplane.
Extreme case: A few centimeters from rhizoplane.

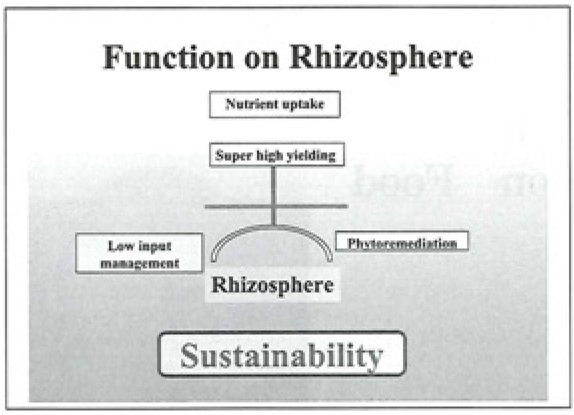

What is Rhizosphere regulation？
Strategy I: Root exudation
Strategy II: Symbiosis with microorganisms
Atmospheric N2 fixation
Rhizosphere
Mycorrhizae
Root
Organic acids
Pathogen
Aluminum
Insoluble phosphorus compounds


Why can not rhizosphere study develop ?
Soil is black box.
Why?
・Chemical species in soil: more than 10,000

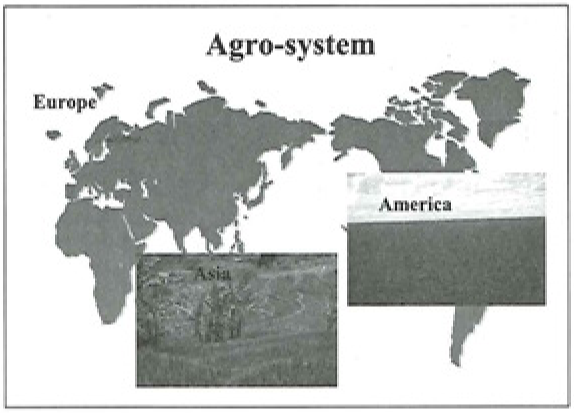

Strategy I: Root exudation
Organic acids exudation
Chelate
Organic acid exudation
Chelate
acid sulfate soil
Al-P
Soil pH =2.0~3.0
Acid sulfate soil
Al3+


Strategy II: Symbiosis with microorganisms
Some Burkholderia isolates can utilize phytate
Uninoculated
Uninoculated
FpRpG3
FpRpG4
FpRpG5

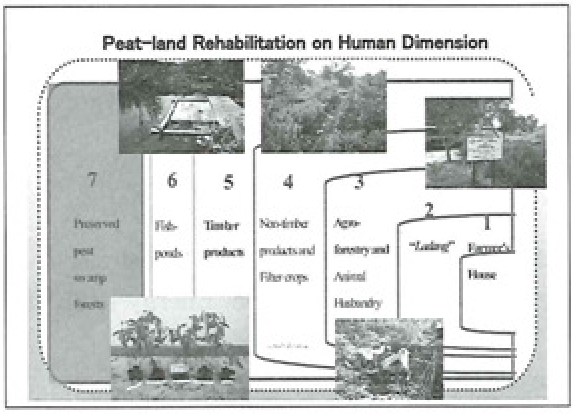

Matrix for microorganisms:
Charcoal



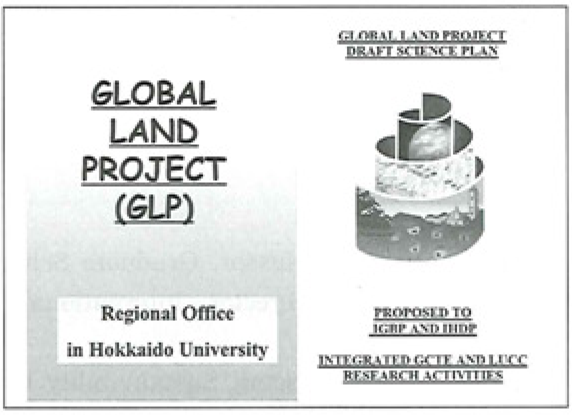
Function on Rhizosphere
Nutrient uptake
Super high yielding
Low input management
Phytoremediation
Rhizosphere
Sustainability



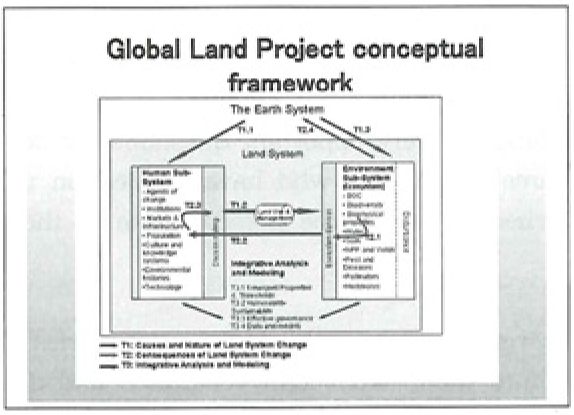
Agro-system
Europe
America
Asia



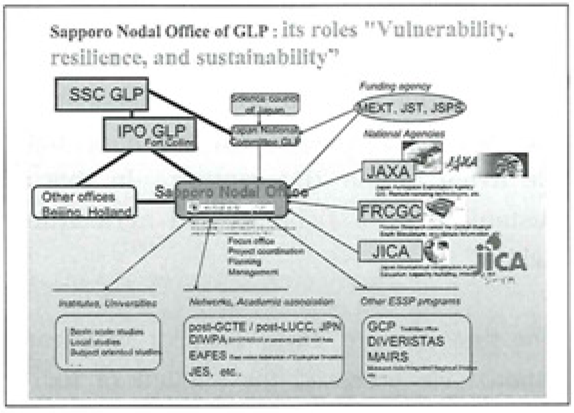
Peat-land Rehabilitation on Human Dimension
7
Preserved peat swamp forests
6
Fish-ponds
5
Timber products
4
Non-timber products and Filter crops
3
Agro-forestry and Animal Husbandry
2
"Lading"
1
Farmer's House



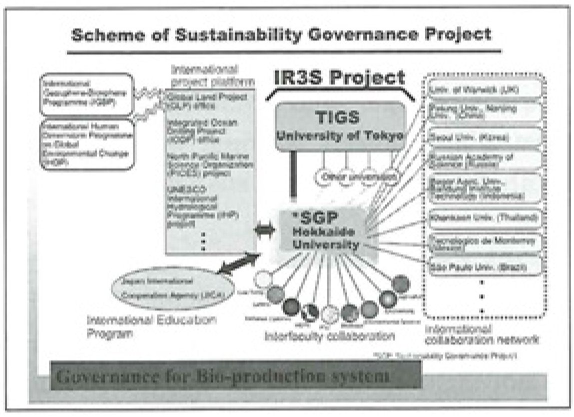
GLOBAL LAND PROJECT (GLP)
Regional Office
in Hokkaido University
GLOBAL LAND PROJECT
DRAFT SCIENCE PLAN
PROPOSED TO
IGBP AND IHDP
INTEGRATED GCTE AND LUCC
RESEARCH ACTIVITIES



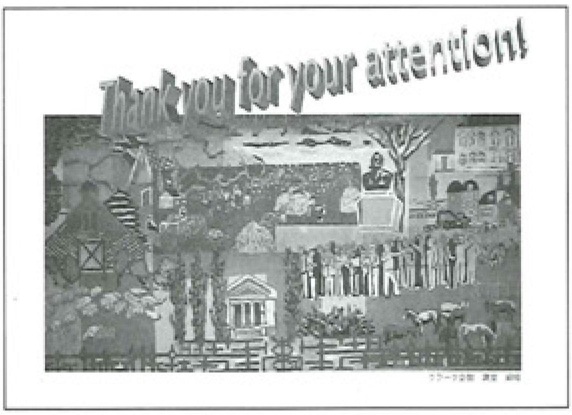
Global Land Project conceptual framework
The Earth System
Land System
Integrative Analysis and Modeling
T1: Causes and Nature of Land System Change
T2: Consequences of Land System Change
T3: Integrative Analysis and Modeling



Sapporo Nodal Office of GLP : its roles "Vulnerability, resilience, and sustainability"
SSC GLP
IPO GLP
Fort Collins
Science council of Japan
Japan National Committee GLP
Funding agency
MEXT, JST, JSPS
National Agencies
JAXA
FRCGC
JICA
Other offices
Beijing, Holland
Sapporo Nodal Office
Focus office
Project coordination
Planning
Management
Institutes, Universities
Basin scale studies
Local studies
Subject oriented studies
Networks, Academic association
post-GCTE / post-LUCC, JPN
DIWPA
EAFES
JES, etc.
Other ESSP programs
GCP
DIVERISTAS
MAIRS



Scheme of Sustainability Governance Project
International Geosphere-Biosphere Programme (IGBP)
International Human Dimensions Programme on Global Environmental Change (IHDP)
International project platform
Global Land Project (GLP) office
Integrated Ocean Drilling Project (IODP) office
North Pacific Marine Science Organization (PICES) project
UNESCO International Hydrological Programme (IHP) project
IR3S Project
TIGS
University of Tokyo
Other universities
*SGP
Hokkaido University
Japan International Cooperation Agency (JICA)
International Education Program
Interfaculty collaboration
Univ. of Warwick (UK)
Peking Univ., Nanjing Univ. (China)
Seoul Univ. (Korea)
Russian Academy of Science (Russia)
Bogor Agric. Univ., Bandung Institute Technology (Indonesia)
Khonkaen Univ. (Thailand)
Tecnologico de Monterrey (Mexico)
São Paulo Univ. (Brazil)
International collaboration network
*SGP: Sustainability Governance Project
Governance for Bio-production system



Thank you for your attention!