**Summary Report of Workshop for the Trilateral Science and Technology Cooperation**

Following the Joint Statement at the 1st Trilateral Ministerial Meeting of Science and Technology Cooperation held in January 12, 2007, in Seoul, Workshop for the Trilateral Science and Technology Cooperation was held with attended by senior level administrators and experts from three countries (Japan, China and Korea), in March 5-6, 2007, at Kyushu University in Fukuoka, Japan.

Through the intensive discussion, we, the experts to attend the workshop from three countries, have become to share the view that the following areas are promising as the starting point of trilateral S&T cooperation. It is our hope that the concrete cooperation in these areas is fully considered in the governments in each of three capitals and at the trilateral inter-governmental meeting (Ministerial- level, Director-General level, and so on).

Promising areas for the trilateral S&T cooperation:

**(1) Water & Ocean Environment: Harmful algal blooms in the East China Sea**

Outline:

The program aims at environment-friendly management and mitigation against HABs to reduce fisheries damage. The program consists mainly of the following 4 parts (the international R & D on (1) & (2) ongoing, (3) & (4) currently planned through co-operation of the 3 countries). (1) Sophisticating phytoplankton-species identification using molecular analysis (not only HAB species). (2) Understanding environmental conditions suitable for growth and proliferation of HAB species. (3) Developing an efficient, state-of-art monitoring system of coastal environment for predicting outbreaks of red tides. (4) Developing measures to reduce fisheries damage through prediction (by satellite and aviation remote sensing for HAB species causing extensive red tides), and information transmission to fishermen and aquaculturists.

Rationale:

Environmental conditions of the East China Sea (ECS) spanning between Japan, Korea and China have been deteriorating due to rapid economic developments of coastal countries. Conservation and restoration of ECS environment, ecosystem and biological productivity is the urgent issue to pursue, and resolving the issue through trilateral S & T cooperation is essential and beneficial for the 3 countries. The first step of collaboration should be to establish an ECS-HAB science network to share scientific data of HAB species, which forms the basis for further collaboration to develop the measures to reduce HAB fisheries damage. The ECS-HAB science network will also be a model case for future international

collaborations in wider rages of marine-related issues in ECS as well as in other marginal seas, such as the South China Sea and the Gulf of Thailand.

**(2) Water & Ocean Environment: Membrane Bioreactor (MBR) R&D for Decentralized and Sustainable Water Reuse**

Outline:

The cooperation project, named "AMBITION" (Asian Membrane Bioreactor Initiative by Trilateral cooperatION), will be a trilateral project to collaborate among the three world-leading laboratories in Japan, China and Korea. The project goal will be to upgrade the MBR (membrane bioreactor) technology by Asian initiatives to cope with current/future Asian mega city problems, which includes R&D of MBR technology to achieve drastic cost reduction, wise energy use, and user-friendly and robust operation. Knowledge exchange and human resource development is also the scope of the project. Evolving the present inter-laboratory activities, a training/guidance scheme for MBR engineers will be proposed to strengthen the competitiveness of the MBR industries in the three countries and to help MBR operators in Asian region and others.

Rationale:

A large number of mega cities are located in Asian region. Membrane bioreactor technology is considered as a key technology for the future decentralized and sustainable water reuse in the mega cities and there is a large market in the growing Asian countries. EU and North America have already initiated the cooperation and standardization schemes on the MBR technology. Japan, China and Korea have been leading in R&D of the MBR technology and established MBR industry. But their cooperation and standardization of the technology is still in the personal or single country level. The trilateral project is required for upgrading the MBR by Asian initiatives, which will attain the leadership of the three countries in Asian region and strengthen the international competitiveness of their MBR industries.

**(3) Atmosphere Environment: Impacts of Anthropogenic Aerosols on Climate in Asia**

Outline:

Anthropogenic aerosols (especially carbonaceous aerosols), which are expected to increase in next decades, have great impacts on climate (IPCC) and have adverse effects on human health. The magnitudes of the climate impacts significantly depend on physical and chemical characteristics of aerosols (size distribution and chemical composition). The impacts of aerosols on climate should be urgently investigated by joint efforts of Japan, China, and Korea in order to formulate effective strategies to mitigate the climate change for socio-economic sustainable development in East Asia. The necessary joint scientific projects

would be as follows: (1) to facilitate networks for reliable measurements of aerosol (especially black carbon) and its physical and chemical properties in East Asia; (2) to develop new aerosol-climate models, which include full aerosol scheme to assess the impacts of air pollution on climate.

Rationale:

Japan, China, and Korea, which are located under the common meteorological and environmental fields in East Asia, are sharing the same adverse effects of air pollution and climate change. The three countries need to closely cooperate in taking necessary steps to solve these problems. Intensive measurements of aerosol in Korea and China have been conducted by research institutes in the three countries. It is important for us to strengthen our capabilities in making systematic measurements of aerosol physical and chemical properties in East Asia and in predicting the effects of aerosols on climate using new numerical models. The regional-scale measurements, modeling, and assessments cannot be achieved by a single country and should be performed by the trilateral cooperation. The results of this project will be shared with all Asian counties, including ASEAN and India, for all our benefits. Because the emissions from Asia have large contributions to global aerosol budgets (with significant uncertainties), the results of this project would be useful to improve the assessments of global climate change by IPCC.

**(4) Atmosphere Environment: Asian Scale Air Quality Modeling and Future Projection -Present Status and Importance of Joint Cooperation-**

Outline:

East Asia is the highest anthropogenic pollutant emission region in the world. Both research results of bottom-up emission inventory and top-down satellite retrieval indicate NO2 increases by 8-10%/year after 2000 over the North China region, though these still include large uncertainties. This rapid increase suggests a strong impact of long-range transport of secondary air pollutants to downwind regions/countries. Current and future projection level of air quality in Asia will reach a critical level from the perspective of air quality standards. This will bring serious problems on terrestrial/oceanic ecosystems and human health. To understand the recent change of Asian air quality more systematically, a data assimilation base integrated modeling system with a better prediction ability must be developed by using field observations, emission inventory, chemical transport model under a constraint of satellite retrieval.

Rationale:

Air quality in East Asia is getting worse due to very rapid economic growth. To keep the

better atmospheric condition, an integrated air quality model plays an important role. However, air quality models including emission inventories have been developed independently in China, Korea, and Japan, and they show some inconsistency compared with satellite observations. Therefore the integrated modeling researches including future emission projections under the trilateral partnership are necessary to improve our correct understanding of current and future air quality change. United Nations Economic Commission for Europe and US EPA established a Task Force on Hemispheric Transport of Air Pollution (HTAP) to understand the impact of global transboundary air pollution, but no counter project exists in Asia. Asian Scale Transboundary Air Pollution Research Joint-Project is required for clear understanding of Asian air quality not only for East Asian scale but also for the hemispheric scale.

**(5) Energy: Extracting Resources from Biowastes**

Outline:

One of the keys to solve energy and resource constraints is to construct a recycling system which extracts material and energy resources from bio-wastes, such as, wastes from farming and wasted food. It is important to conduct the project to focuse on research of extracting resources from bio-wastes by refinery technology which means cascade utilization of bio-wastes. The project includes: refinery technology (extraction of chemicals and their application, conversion to gas/liquid fuels, conversion to thermal energy); characterization of useful and hazardous chemicals in bio-wastes and in refinery process; social/economic/environment assessment and management of bio-wastes and the refinery technology; and evaluation of interaction of all parts of the refinery technology for developing integrated system.

Rationale:

Three countries have common serious issues: exhaustible petroleum resources; domestic and trans-boundary environmental problems such as air pollution, acid rain and global warming caused by usage of fossil fuels. In addition, three countries are in strong mutually dependent relations in bio-resource supply and consumption in primary industrial sectors. Then three countries should promote utilization of bio-wastes to tackle with the issues mentioned above.

The project will contribute to the effective usage of bio-wastes not only for generating bio-energy but also for developing bio-energy and bio-chemical products and accelerate paradigm shift from petroleum-based society to renewable bio-resource based society.

**(6) Energy: Novel Conversion Processes for Biomass Utilization Using Aqueous Systems**

Outline:

This trilateral collaboration will provide and establish novel green processes for biomass utilization as an eco-friendly, low-energy, low-cost and sustainable material-producing method.

For that, the respective methods proposed by the three groups should be combined: The nano- pulverization by “Counter collision in water”, successfully decomposes only the interaction, and finally liberates the components including nanofibers at various sizes into water to provide a transparent and homogeneous component/water system. This method is employed as a pretreatment for dissolution of cellulose in aqueous solution producing regenerating fiber and saccharification of lignocellulosic biomass as a source of bio-ethanol using supercritical water.

Rationale:

As an alternative of fossil fuels, biomass energy conversion has attracted much attention among China and Korea, as well as Japan. However, much less attention for the biomass conversion into bio-based materials is paid at present. The biomass conversion technology for the utilization has some difficulties to be solved, independently of the countries. The bottleneck is a relatively high energy cost, slow process and a complicated processing for final products. It should be also noted that international sharing of new technologies is also negotiable among the countries.

In this collaboration with mutual understanding and trust of the three respective groups from China, Korea and Japan, the novel conversion methods of biomass resources using aqueous system that are successfully combined with the individual new method can overcome the disadvantages, finally leading to a rapid, low-energy cost and more effective conversion process.

**(7) Fundamental Technology: Environmental Management Technology for Sustainable Utilization of Environmental Resources in East Asia**

Outline:

This project tries to develop environmental management technology by:a) predicting the degradation of environmental resources with an integrated assessment model include estimation of environmental impact through global trade based on monitoring the present stocks of environmental resources by satellite networks and ground observation system, b) developing the innovative regional grand-design for utilizing bio-fuel as renewable energy source which reduces growing dependence on fossil energy, air pollution and greenhouse gas emission based on the innovative regional management schemes consisting of the optimal application of water-energy and organic material recycling technologies of different scales,

with suitable land use allocation. The achievement of this project is to function as a fundamental technology platform for finding sustainable solutions by designing innovative technology society in East ASIA.

Rationale:

Food, biomass energy, water resources and water pollution which are inter-linked among each other would be the most dominant limiting factors for sustainable growth in East Asia. The continuous degradation of environmental resources and imbalanced consumption of natural resources caused by overhasty economic development and excessive dependence on international trade are raising strong concerns to damage environmental security in East Asia.

Integrative environmental management technology will enable the region to choose and design the most suitable sets of technological and societal system, with the bio fuel energy technologies which is top policy priority for each government, and supporting societal schemes and infrastructures as crucial drivers, which are consistent with local and regional characteristics.

March 6, 2007
Fukuoka, Japan

Annex: The List of Experts
The experts to attend the workshop from three countries:

(Japan)
Prof. MATSUOKA Kazumi, Nagasaki University
Prof. YAMAMOTO Kazuo, The University of Tokyo
Assistant Prof. TAKEGAWA Nobuyuki, The University of Tokyo
Prof. UNO Itsushi, Kyushu University
Prof. HASEGAWA Tatsuya, Nagoya University
Prof. KONDO Tetsuo, Kyushu University
Prof. WATANABE Masataka, Keio University

(China)
Dr. YU Rencheng, Institute of Oceanology, Chinese Academy of Sciences
Prof. HUANG Xia, Tsinghua University
Prof. ZHANG Yuanhang, Peking University
Prof. WANG Zifa, Institute of Atmospheric Physics, Chinese Academy of Sciences
Prof. XIE Yusheng, Institute of Process Engineering, Chinese Academy of Sciences

Prof. ZHANG Lina, Wuhan University
Prof. LIU Jiyuan, Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences

(Korea)
Dr. KIM Hak-Gyoon, Pukyong National University
Prof. LEE Chung-Hak, Seoul National University
Prof. KIM Young Joon, Gwangju Institute of Science and Engineering
Prof. PARK Soon-Ung, Seoul National University
Prof. LEE Sang-Chun, Kyungnam University
Prof. CHOI In-Gyu, Seoul National University
Dr. KANG Sang-In, Korea Environment Institute